



Připravte si infrastrukturu na novou realitu

Bezdrátové sítě | 23. 6. 2020

Vítejte



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# Připravte si infrastrukturu na novou realitu

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Pavel Křížanovský

Technický ředitel,  
Cisco Systems CZ & SK



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Možnosti interakce – ankety + Webex Q&A



Link na interaktivní polling:  
<https://pollev.com/ciscoczsk523>



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# Program



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## Blok 1

9:30	Rozhovor s expertem – Petr Krčmář, šéfredaktor root.cz Losování soutěže root.cz	<i>Pavel Křížanovský</i>
9:45	Poznejte možnosti Wi-Fi6 a WPA3	<i>Jarda Čížek</i>
10:00	Jak se staví WLAN síť?	<i>Milan Rášo</i>
10:15	Jak vybírat komponenty pro síť Wi-Fi6? (část 1)	<i>Jarda Čížek</i>
10:30	Jak vybírat komponenty pro síť Wi-Fi6? (část 2)	<i>Milan Rášo</i>
10:45	Shrnutí úvodní části	

Přestávka

## Blok 2

10:55	Proč jsme přešli na Wi-Fi6 - zkušenost společnosti Teleplan	<i>Pavel Křížanovský</i>
11:05	Mějte Wi-Fi pod kontrolou - živé demo	<i>Zdeněk Roubal, Jarda Čížek</i>
11:15	Monitoring - analytika - integrace	<i>Zdeněk Roubal</i>
11:30	Návod: úspěšná migrace na Wi-Fi6	<i>Jarda Čížek, Milan Rášo</i>
11:45	Závěrečné shrnutí	

11:50 Otázky a odpovědi

12:00 Závěr



# Připravte si infrastrukturu na novou realitu

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Petr Krčmář  
šéfredaktor [root.cz](http://root.cz)



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# Losování soutěže

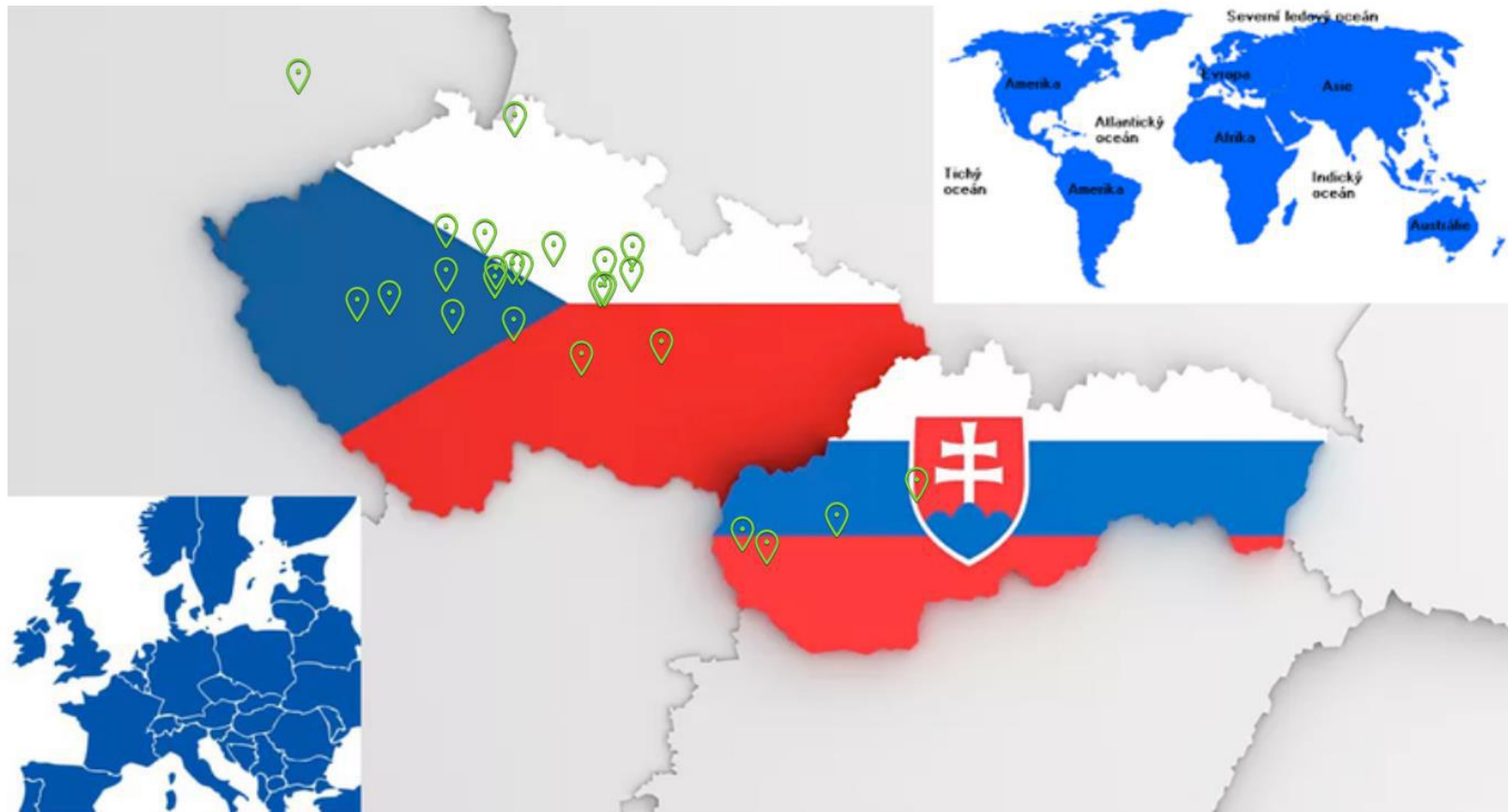
Celkový počet účastníků: 739

Počet správných odpovědí: 651



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# Odkud jste připojeni na dnešní konferenci ?





# Připravte si infrastrukturu na novou realitu

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Jaroslav Čížek

Systems Engineer – Enterprise Networking,  
Cisco Systems CZ



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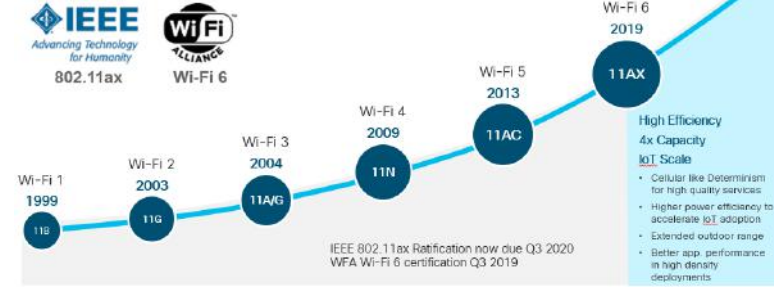


# Poznejte možnosti Wi-Fi6 a WPA3

Jaroslav Čížek

Systems Engineer – Enterprise Networking, Cisco Systems CZ

# What is Wi-Fi 6?



## Higher Performance

Higher per-device peak speed in high density, high throughput environments

Enabled by: OFDMA, MU-MIMO, BSS Coloring, 1024-QAM

## Higher IoT Scale

Significantly improved device battery life along with enhanced coverage

Enabled by: OFDMA, MU-MIMO, TWT



## Higher Efficiency

Better resource utilization with increased efficiency and lower latency

Enabled by: OFDMA, MU-MIMO, BSS Coloring

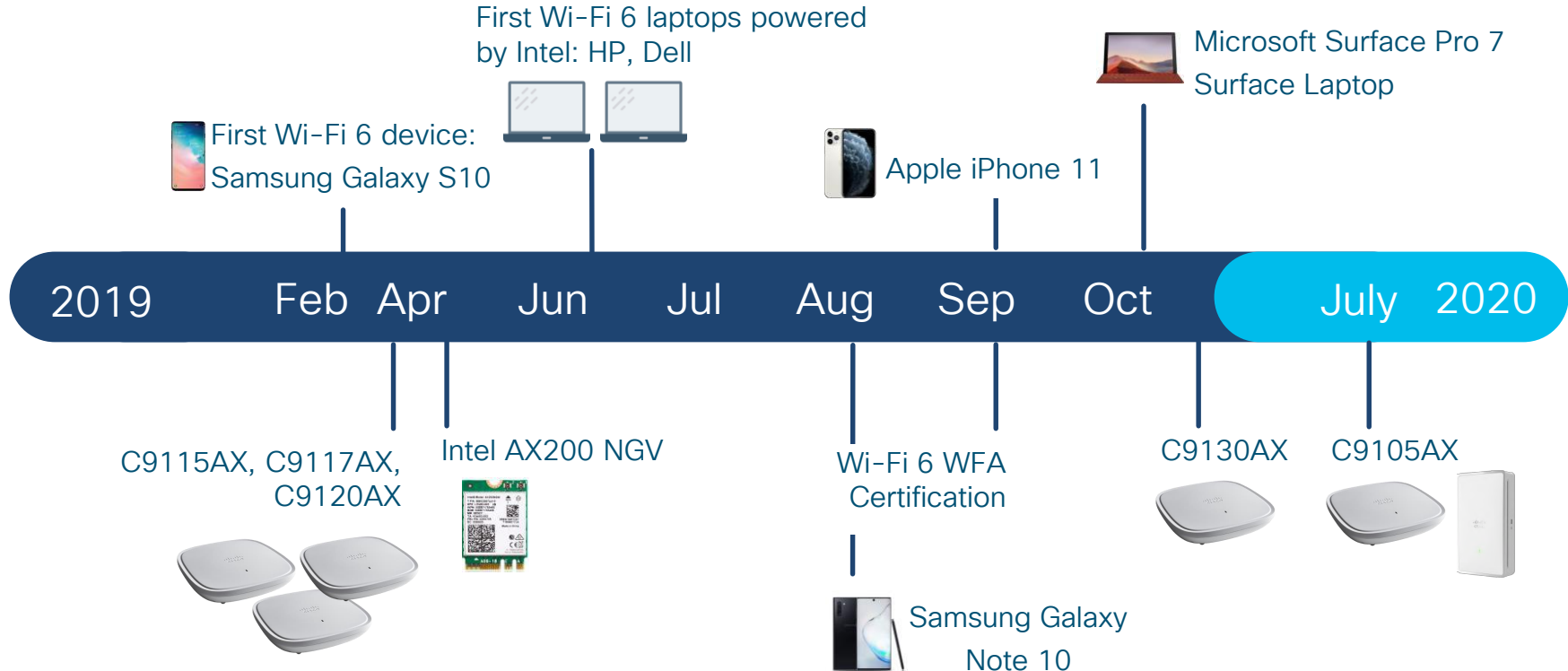
## Higher Security

Augmented with WPA3

OFDMA: Orthogonal Frequency Division Multiple Access  
MU-MIMO: Multi-User Multiple Input Multiple Output  
BSS: Basic Service Set  
TWT: Target Wait Time  
QAM: Quadrature Amplitude Modulation

Faster Speeds | Optimized Capacity | IoT Ready

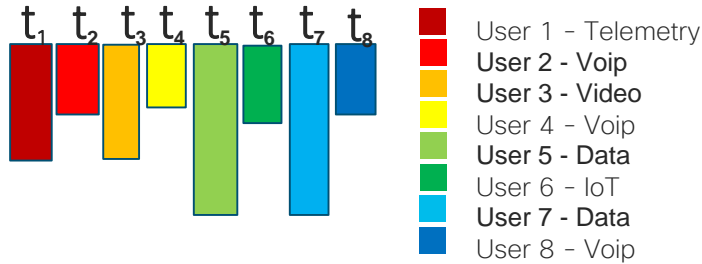
# Wi-Fi 6 is here!



# Wi-Fi 6 OFDMA – Using subcarriers more efficiently

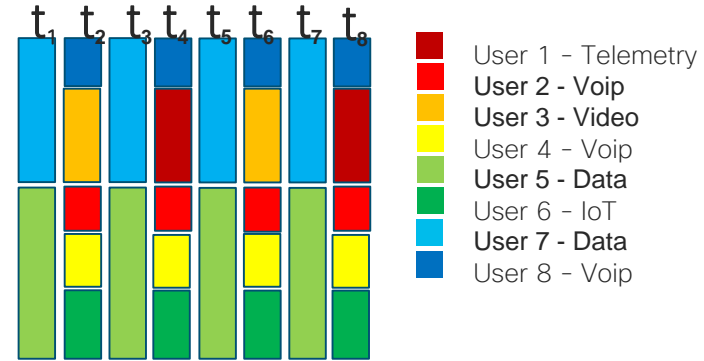
Maximizing Client Count – Lowering Latency

## OFDM



- Each User gets 1 time slot – and uses the whole channel bandwidth
- In this example with 8 users, each User will wait  $t_8$  before Next Tx\_op (Assuming no QoS)
- As more clients Join the cell, Latency –and Jitter Increases

## OFDMA



- Multi user Packet makes flight more efficient
- Much more regular and consistent TX\_op
- Deterministic nature –
- Multiplexing Users onto Single frames, reduces overhead, and Latency

Each subcarrier is a transport – Latency goes up when subcarriers go out “half empty” ... OFDMA solves this by allowing multi-user packets to go out on one subcarrier

# Understanding OFDMA Resource Units

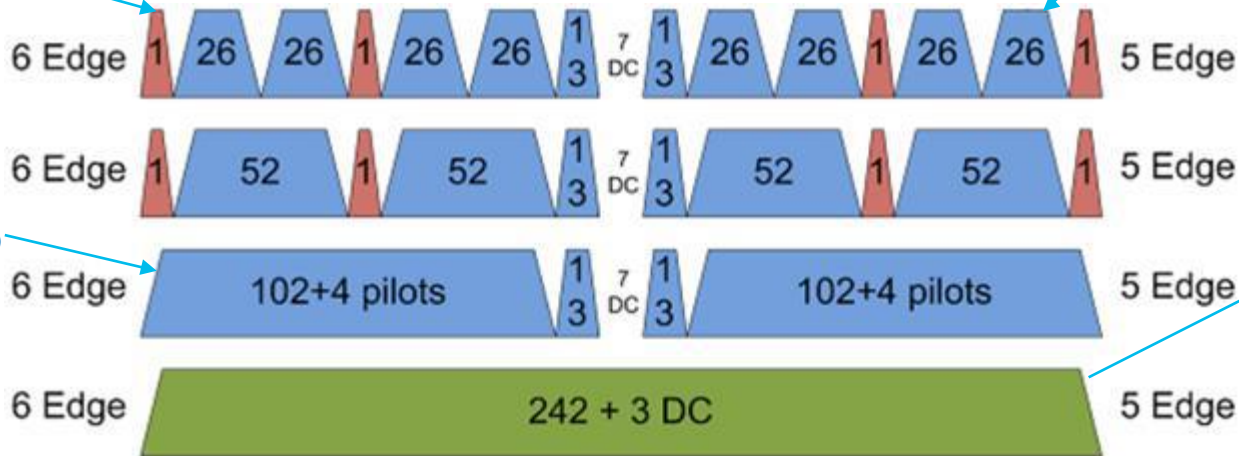


Each RU can be a different modulation scheme or coding rate determined by control information, scheduling etc.

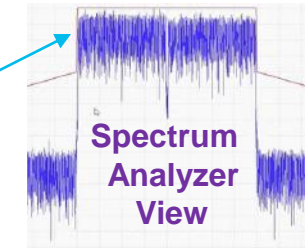
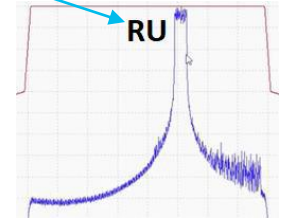
Up to 9 users per 20 MHz  
Tiny RUs ideal for IoT

RU's are indexed

## 20 MHz Channel RUs



Min. RU size  
For MU-MIMO



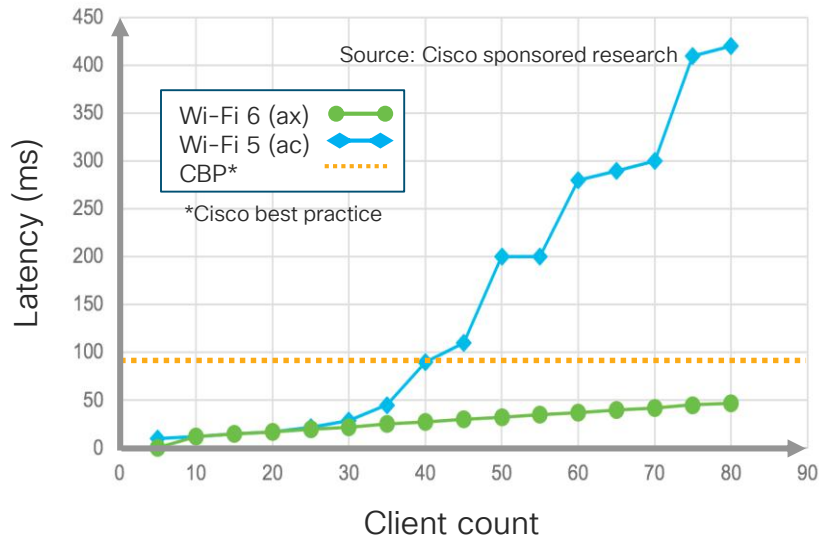
20 MHz

<http://www.ni.com/white-paper/53150/en/>

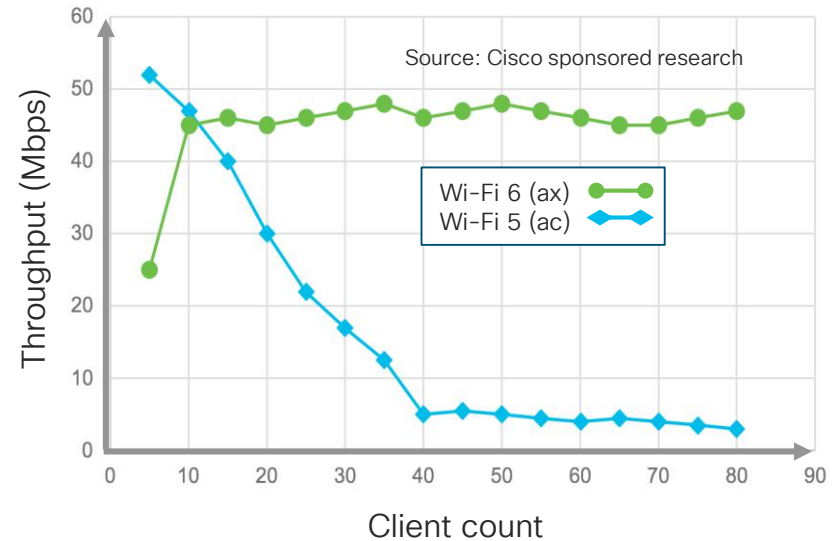
# Wi-Fi 6 OFDMA provides determinism at scale

Enabling high-quality voice/video/data services cost effectively

## Linear VOICE delay



## Consistent DATA throughput



Wi-Fi 6 is not only cost-effective and ubiquitous but is now capable of delivering SLAs

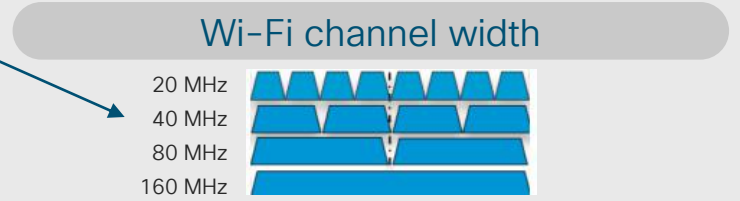
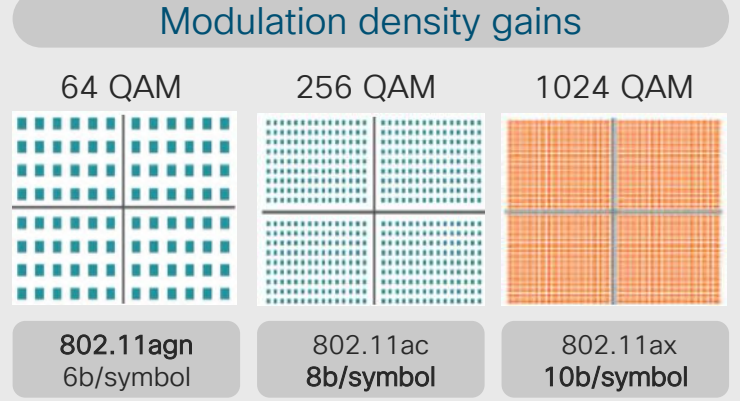


# Wi-Fi 6 Higher data rates – up to 1024 QAM

Getting the most benefit per transmission –

- Four things determine Air time efficiency

1. **Data rate (Modulation density) or QAM** – (how many Bit's per Radio Symbol) 64 QAM is more robust but 1024 QAM is a lot faster
2. **Number of spatial streams and spatial reuse** (introduction of OFDMA and Resource Units) and UL/DL MU-MIMO
3. **Channel bandwidth** – How Many frequencies can we modulate at one time
4. **Protocol overhead** – Preamble/Ack/BA, Guard Interval “GI” etc.



Note: Channel Bonding reduces range as the power is spread out with each additional 20 MHz adding a 3 dB penalty in SNR and the greater the QAM the harder it is for the receiver to decode therefore it is more sensitive to noise.

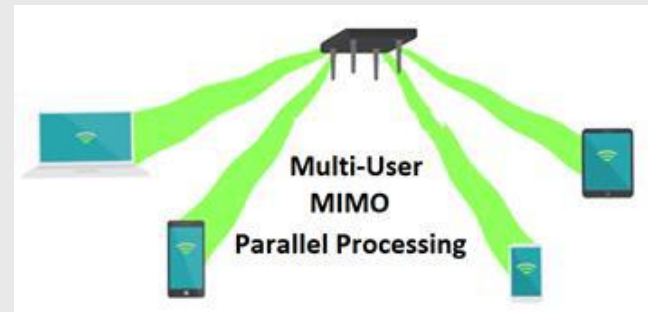
# Wi-Fi 6 enhancements to Multi-User MIMO

## OFDMA changes the game

- Up to 8 MU-MIMO transmissions (Concurrent users in a group) for any RU 106 or larger
- MU Station UL and DL CSI/ACKs/CTS processed in parallel - **Efficient** Leveraging new UL-MU MIMO analogue requirements
- AP maintains a channel matrix for each station and simultaneously beam steers to different clusters of users (managing users as groups)
- Each MU-MIMO client transmission can have different MCS rate
- Larger RU frames 106 and above are used for MU-MIMO
- MU and SU-MIMO is decided by AP w/MU- being favored for larger packets

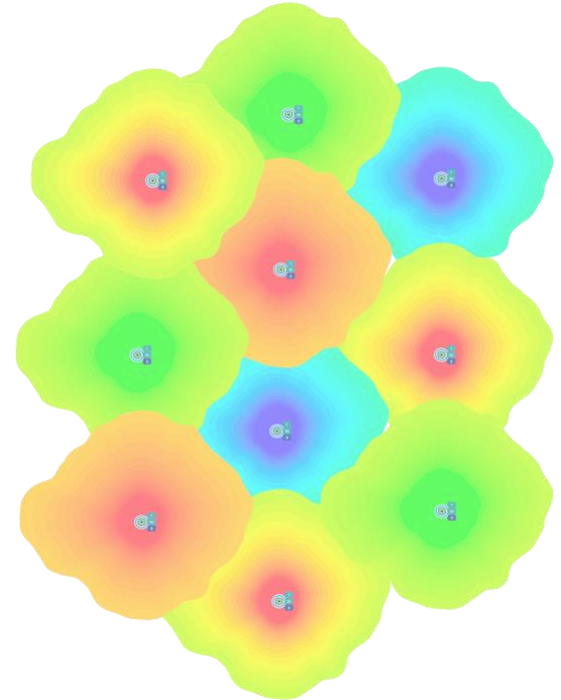


Wi-Fi 6 drives Performance into the clients



# Wi-Fi 6 BSS Coloring

- Wi-Fi 6 BSS Coloring provides a framework for discovering and measuring Spatial Reuse (SR) opportunities
- Spatial Reuse benefits Wi-Fi by providing
  - Increased throughput and airtime efficiency/less interference
  - Supports better High Client Density designs
- Better ground level neighbor information, less CCI through RRM

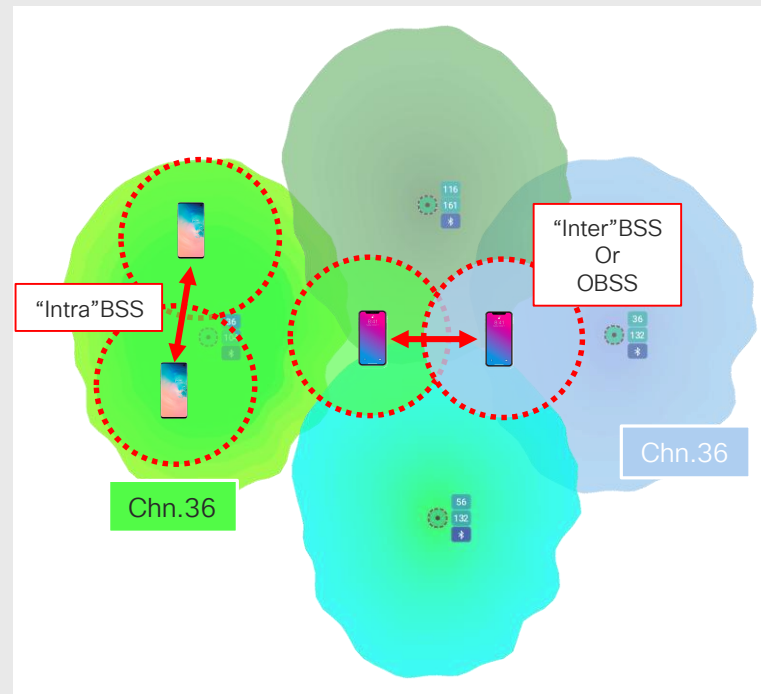


# Wi-Fi 6 BSS Coloring – Spatial Reuse – Basic service set “BSS” and the overlapping basic service set “OBSS”

- All clients associated on a given AP are operating within the same BSS and will operate on the same BSS color (regardless of the SSID)
- Stations operating on a different AP, may have the same SSID and channel – but will be assigned a different color than mine.
- Each user (station) learns its BSS’s color upon association
- Stations detecting the same BSS color (intra-BSS) operate at the default (PD) CCA -82 dBm
- Stations detecting a different BSS color (Inter-BSS) \*may be able to use a higher CCA threshold (lower contention i.e -81 to -62 dBm) through \*\*OBSS-PD and re-use lost space

Every Client becomes a sensor reporting what they can hear from the floor – in realtime

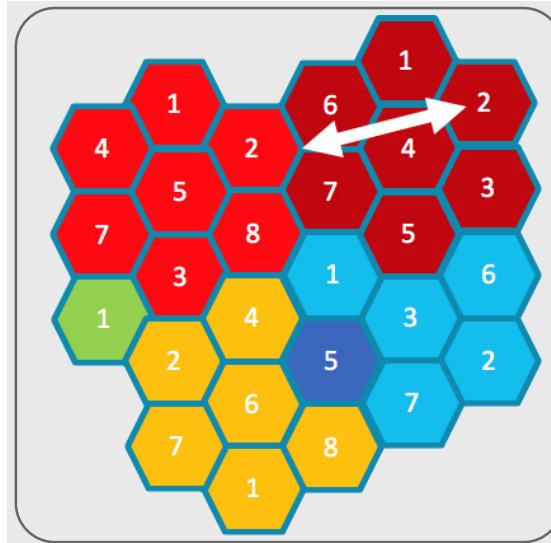
\*RRM will make the determination and assignment  
\*\*OBSS-PD Overlapping BSS – Packet Detection



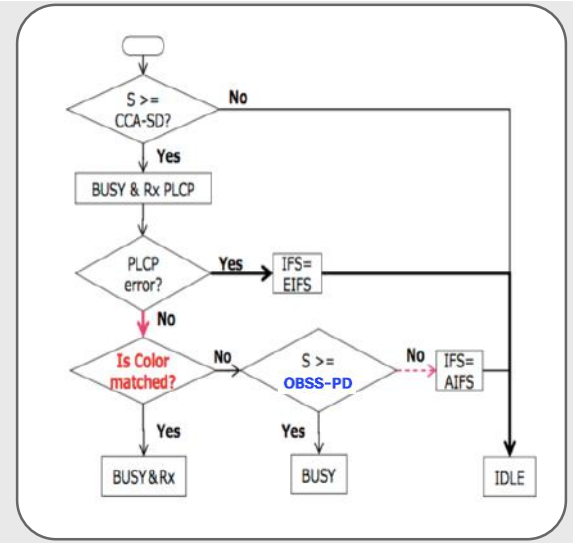
# BSS-Color and RRM

## RRM Manages Color's

- Automated RRM Color assignment
- Identifying SR (Spatial Reuse) opportunities
- Analyze and exploit future SRs



Same channel BSS only blocked on the color match



Channel access rules

# Wi-Fi 6 - Target Wake Time

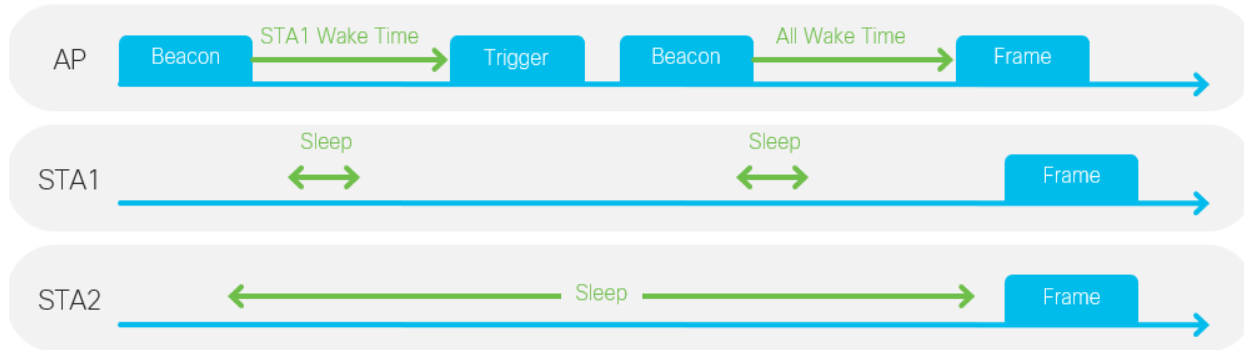
Better Battery Life and co-existence via RF efficiency improvements



## Target Wake Time

With Target Wake Time (TWT), the AP can schedule phones and IoT devices sleep for long durations (up to 5 years) and then wake the individual device up.

Devices can be configured to wake up as a group to communicate at the same time sharing the channel for increased network capacity and reduced battery drain.



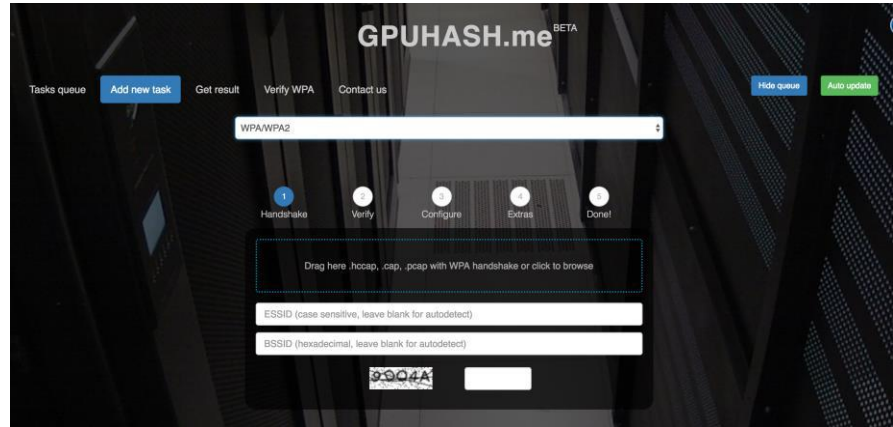
**Same Scaling as 802.11ah, 11ax allows STAs to sleep longer minutes, hours or maybe even days (in theory up to 5 years).**

Image source: Broadcom

# Why is it easy to crack WPA2-Personal?

- All I need is a capture of the 4-Way handshake
  - How?– deauth the client
- Upload the entire pcap
- Customers/end users deploy weak passwords
- Results in a easy access to the Wired network (I don't care about capturing over the air data)
- If my intent is to get wired side access MAC based auth + PSK is trivial to bypass

Think IoT, Medical devices, TV's etc etc



# Wi-Fi Protected Access (WPA) 3

Coming up with Cisco 802.11ac W2 and Wi-Fi6 APs



New Wi-Fi Alliance (WFA) certification

It certifies new security options defined in the IEEE 802.11-2016 standard

3 main innovations:

- **Simultaneous Authentication of Equals (SAE)** for **WPA3-Personal** (a variant of the Dragonfly handshake, resistant to offline dictionary attacks)
- **Protected Management Frame (PMF)** now **mandatory** with WPA3 (already available but not always enforced)
- **192-bit security** equivalent for **WPA3-Enterprise** (256-bit AES-GCM + 384-bit elliptic curves + SHA384 + 3072 bits RSA keys)

WPA3-Personal = WPA3 PSK based SSID  
WPA3-Enterprise = WPA3 802.1X based SSID

WPA3 Mandatory Features

- **Simultaneous Authentication of Equals (SAE)**
- PSK replacement / Offline attack resistance
- **Protected Management Frames (PMF)**
- **KRACK Testing**

WPA3 Optional Features

- **Suite B Cryptography**

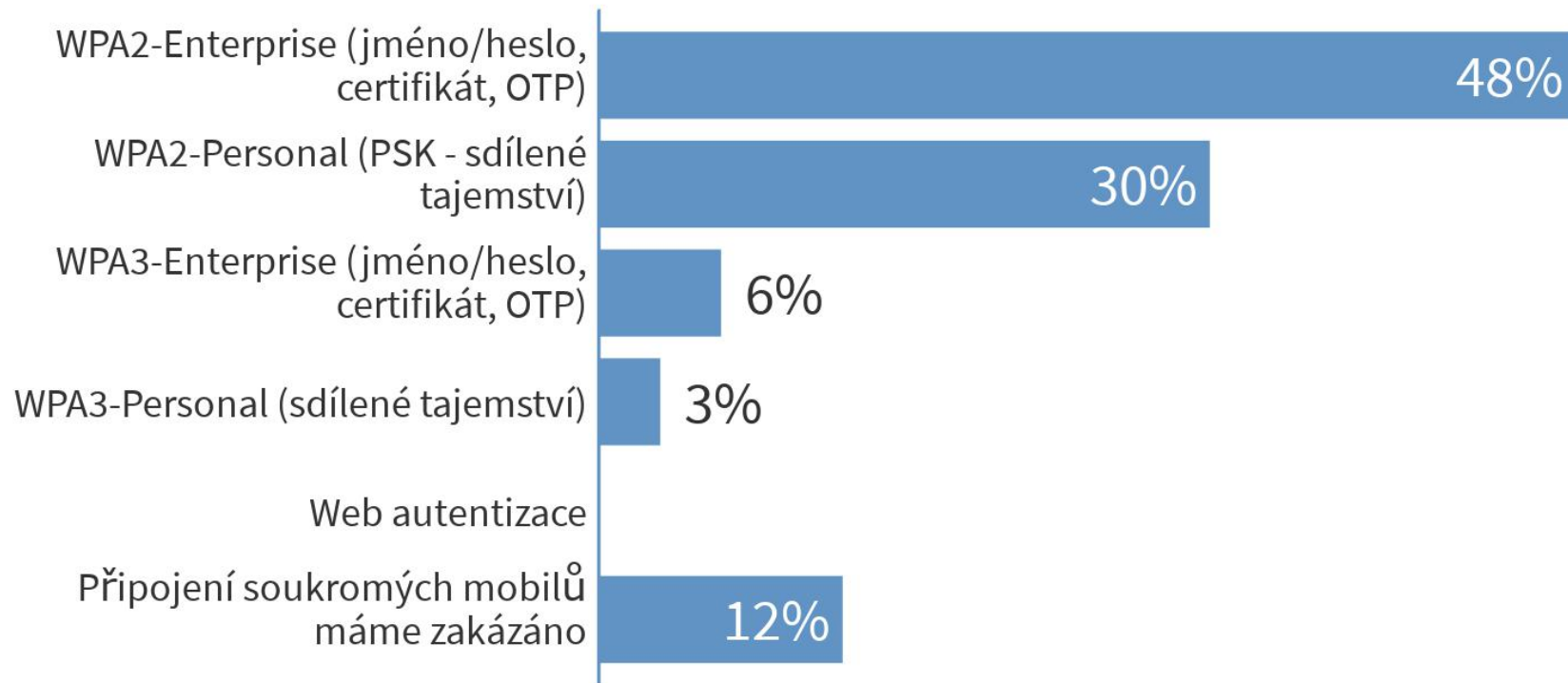
*Wi-Fi Certified Enhanced Open*

- *Opportunistic Wireless Encryption (OWE)*
- *Encryption for Open SSIDs*

*Wi-Fi Certified Easy Connect\**

- *Device Provisioning Protocol (DPP)*
- *Setup for devices with no UI / IoT*

# Jak se autentizujete do Vaší firemní Wi-Fi sítě z Vašeho mobilu?



# Shrnutí – Wi-Fi 6 a WPA3

- Wi-Fi6
  - Celkově vyšší kapacita sítě
  - Vyšší přenosové rychlosti
  - Nižší latence a vyšší dostupnost
  - Nižší spotřeba klientských zařízení
- WPA3
  - Výrazně vyšší úroveň zabezpečení než v případě WPA2



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Milan Rášo

Systems Engineer – Enterprise Networking,  
Cisco Systems SK



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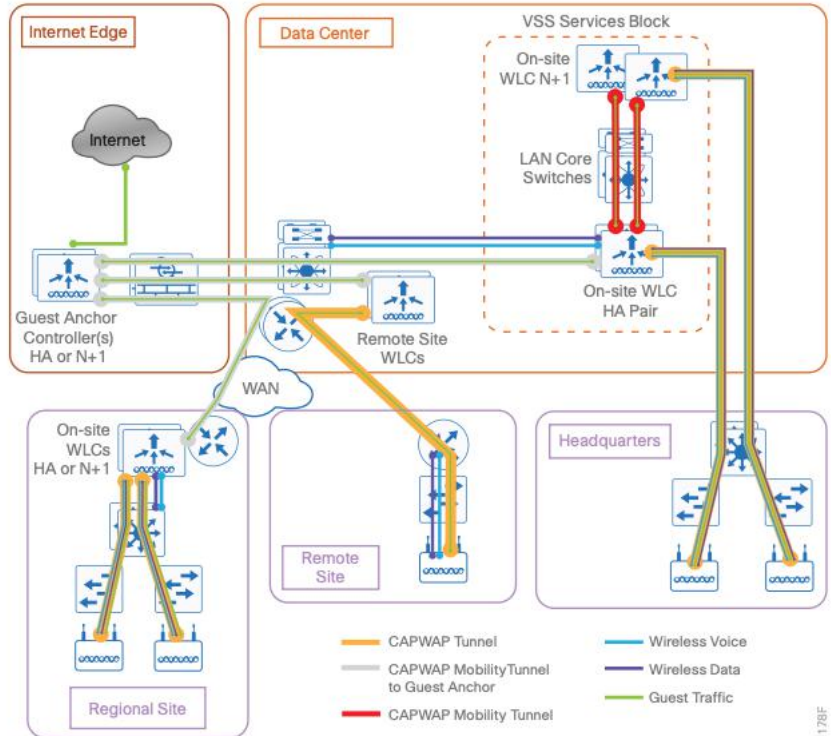
# Jak se staví WiFi síť

Milan Rášo

Systems Engineer – Enterprise Networking, Cisco Systems SK

# Cisco Unified Wireless Architecture

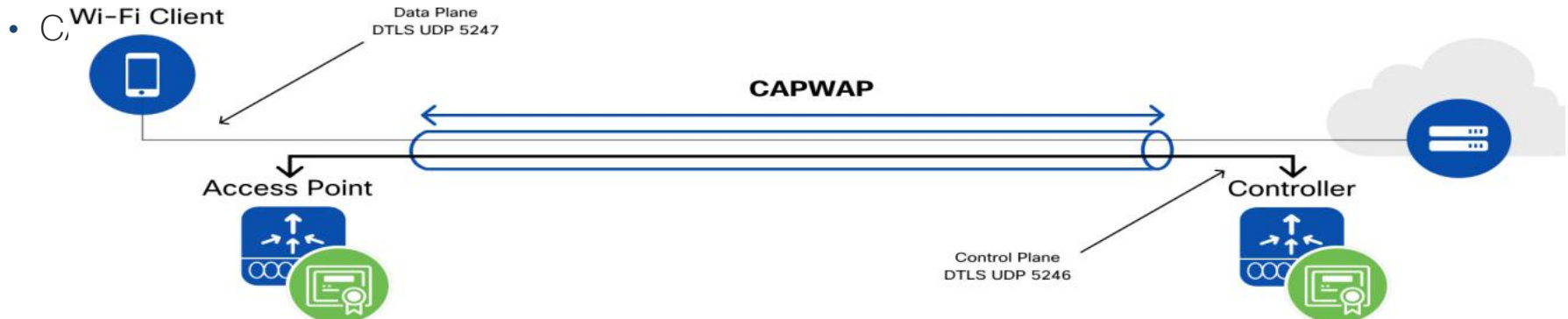
<p><b>Services</b></p>  <p>CMX      Cisco DNA Spaces</p>	<ul style="list-style-type: none"> <li>- Client Location</li> <li>- Location Analytics</li> <li>- Operational Insights</li> </ul>
<p><b>Network Management</b></p>  <p>Cisco DNA Center      Prime Infrastructure</p>	<ul style="list-style-type: none"> <li>- Automation</li> <li>- Assurance</li> <li>- Management</li> <li>- Reporting</li> </ul>
<p><b>Wireless LAN Controller</b></p> 	<ul style="list-style-type: none"> <li>- AP Management</li> <li>- Radio Resource Management</li> <li>- High Availability</li> <li>- Client Mobility</li> <li>- Security</li> </ul>
<p><b>Access Points</b></p> 	<ul style="list-style-type: none"> <li>- CleanAir</li> <li>- Hyperlocation</li> <li>- Client Coverage</li> <li>- Flexible Radio Assignment</li> <li>- Over the Air Encryption</li> </ul>



# Centralized Wireless LAN Architecture

## What is CAPWAP

- CAPWAP: Control and Provisioning of Wireless Access Points is used between APs and WLAN controller and based on LWAPP over IPv4 or IPv6
- CAPWAP carries control and data traffic between the two
  - Control plane is DTLS encrypted
  - Data plane is DTLS encrypted (optional)
- LWAPP-enabled access points can discover and join a CAPWAP controller, and conversion to a CAPWAP controller is seamless



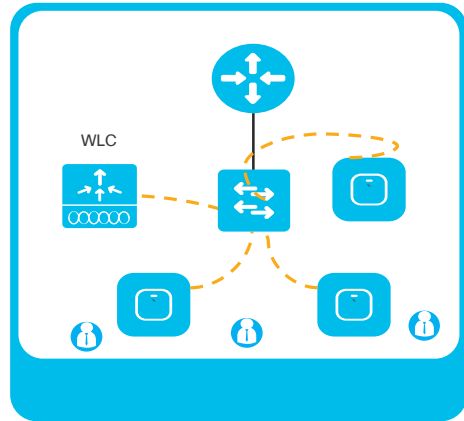
# Wireless Design Options

## Dedicated Local Controller

## Embedded Local Controller

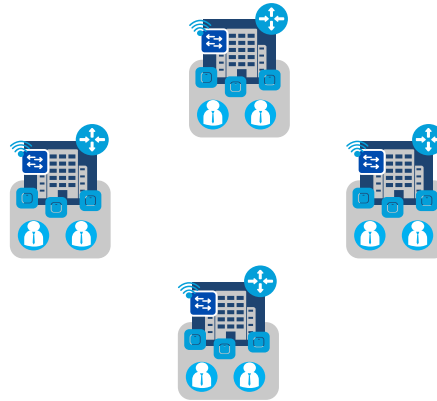
## Remote Controller

### Local Controller



Local WLAN Controller

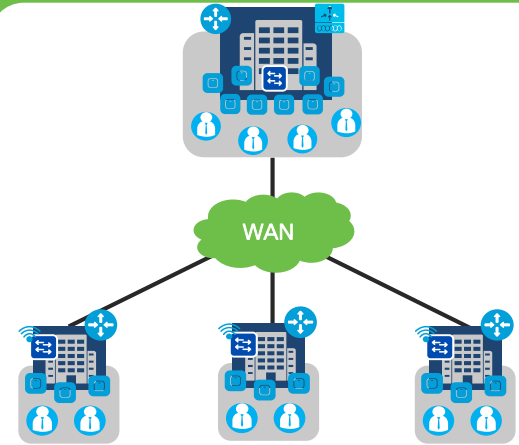
### Embedded Controller Options



Single or Multi-Site

Single/Multi-site networks  
Low IT footprints  
Controller running on AP or Switch

### Flex Connect



FlexConnect

Controller running in Data Center  
Distributed Network  
Highly Scalable



Policy



Automation



Assurance

Cisco DNA Center



Security



ISE

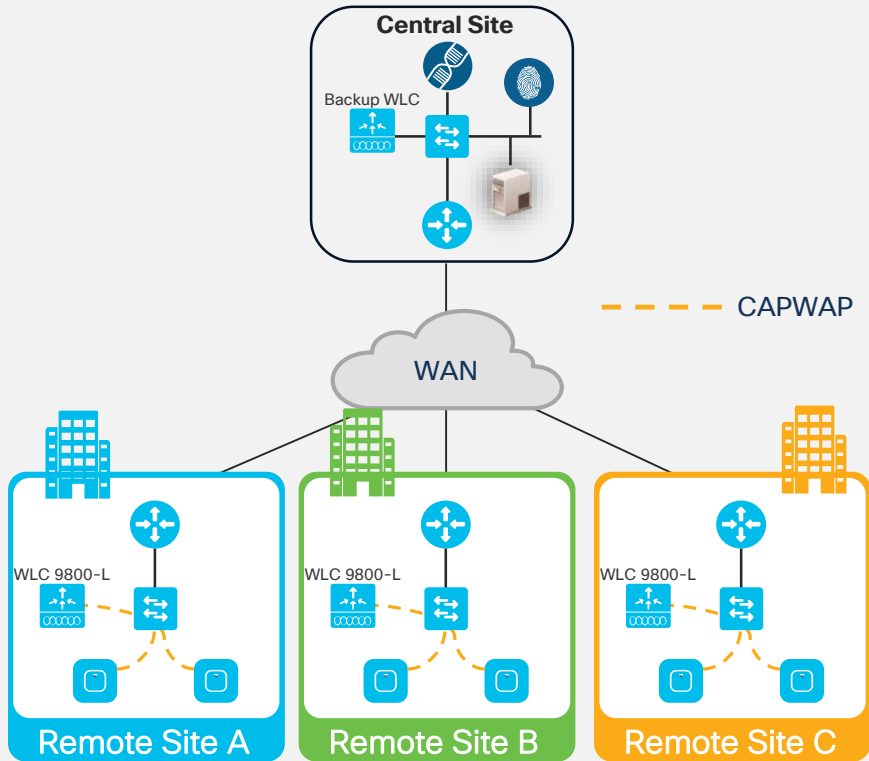


CMX



rights reserved.

# Branch Office with dedicated WLAN Controller



- Branches can have Local Controllers
- Small or mid branch WLC 9800-L , 9800-CL (NFVIS or Virtual)



- Layer-3 roaming with controller in each branch
- Full local control, no dependency on WAN



- WLC at each site, higher Capital Costs
- Higher OpEX costs

# Branch Office with Embedded WLAN Controller



## Catalyst 9800 for Catalyst Switch

Scale to 200 APs and 4,000 Clients

SDA Fabric

Supported on Catalyst 9300, 9400 and 9500 Series switches



## Catalyst 9800 for Catalyst Access Point

Scale to 100 APs and 2000 Clients

FlexConnect Local Switching

Support on Catalyst 9100 Series access points

### Branch Site



Controller on C9k Switch

### Branch Site



Controller on AP



- Branches can have Local embedded Controllers
- No Separate Appliance

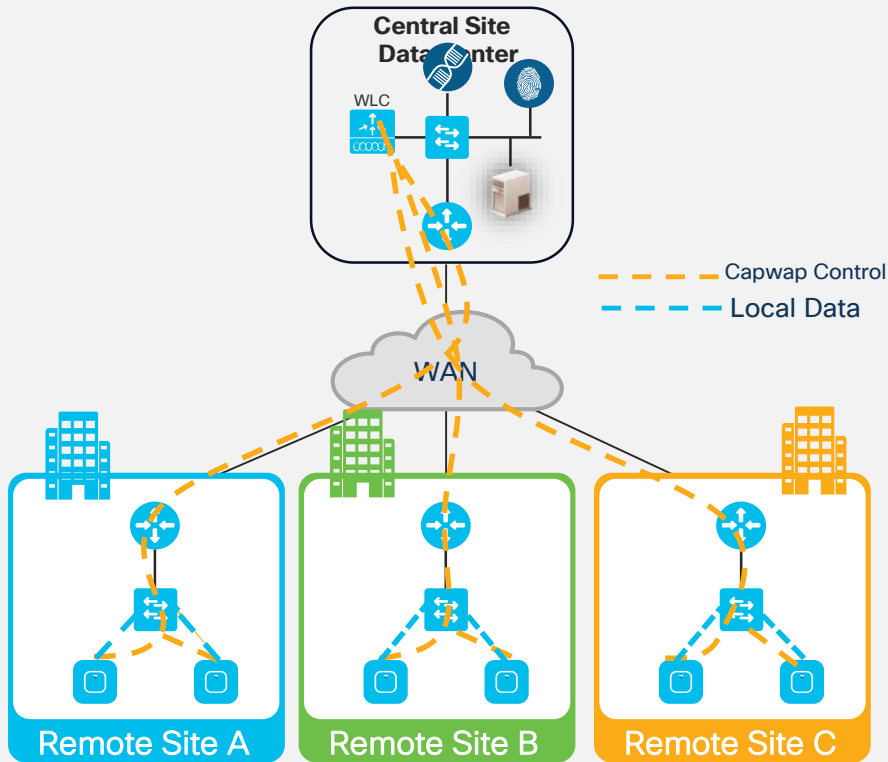


- Full local control, no dependency on WAN
- Cookie Cutter configuration for each branch



- Embedded controller on Cat9k switch is SDA Fabric only
- Embedded controller on AP is local switching only

# Branch Office with Flex Connect (Remote Controller)



- Wireless Controller is at a central site managing AP's across sites/branches
- Clients in branch roam independently



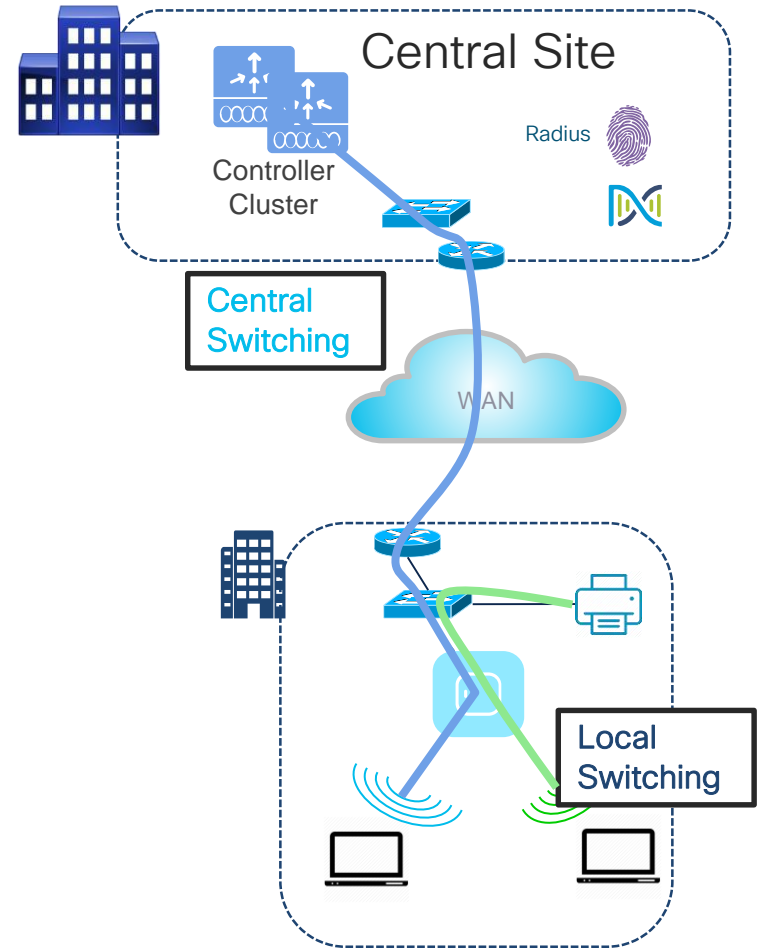
- Each site can have up to 100 AP's in a Flex connect group
- Client data is switched locally in the branch
- Supports standalone mode operations



- Highly Scalable
- Central management
- Supports optional central switching

# Introducing FlexConnect

- Ease of Management via Controller
- CAPWAP management and data plane are split:
  - **Central Switching** (SSID data traffic sent to WLC)
  - **Local Switching** (SSID data traffic sent to local VLAN)
- Two modes of operation from AP perspective:
  - **Connected** (when WLC is reachable)
  - **Standalone** (when WLC is not reachable)



# Cisco SD-Access

- The Foundation for Cisco's Intent-Based Network

## Identity-Based Policies

For Group and Network Segmentation



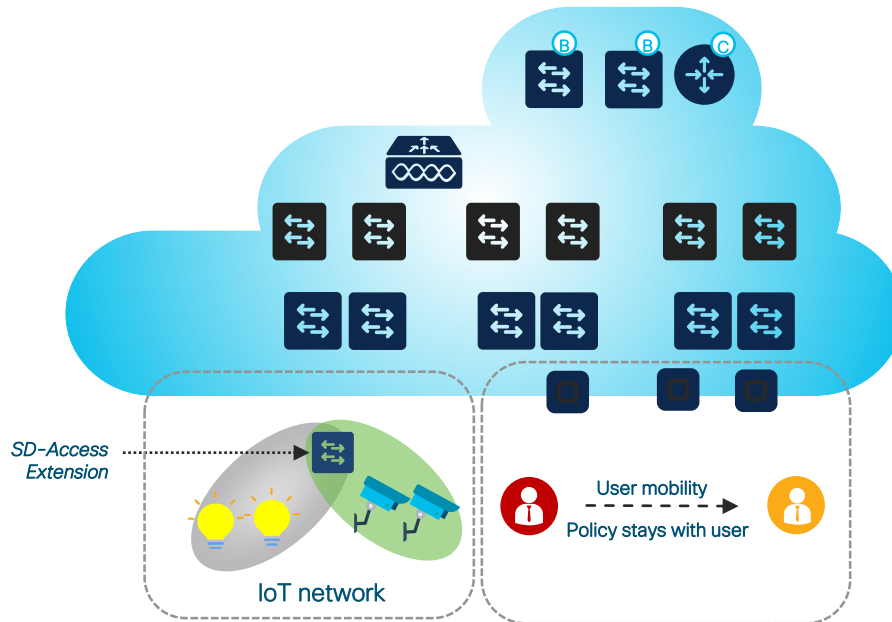
## One Network Fabric

For Wired and Wireless, across Campus, Branch & IoT

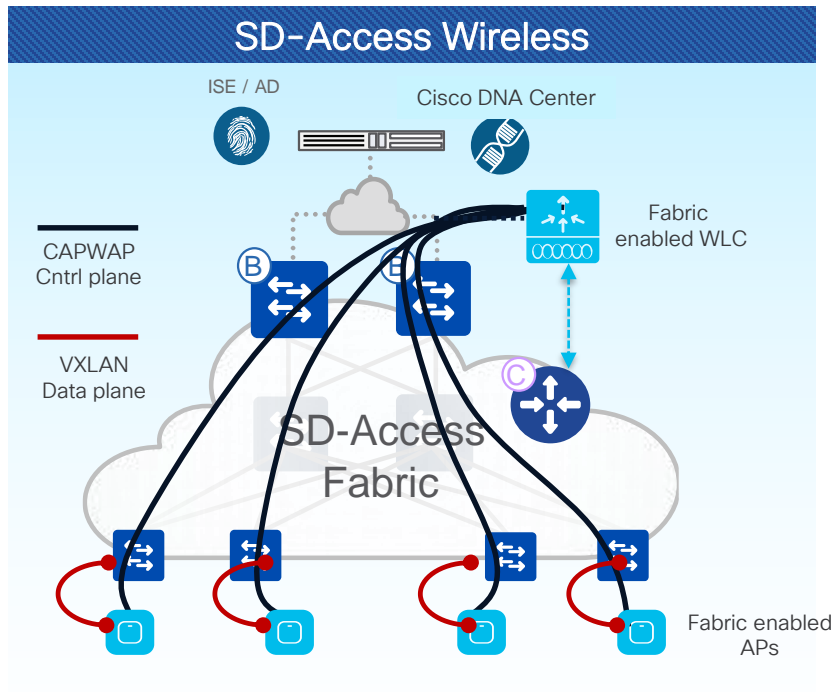


## Insights & Telemetry

Into User & Application Experience



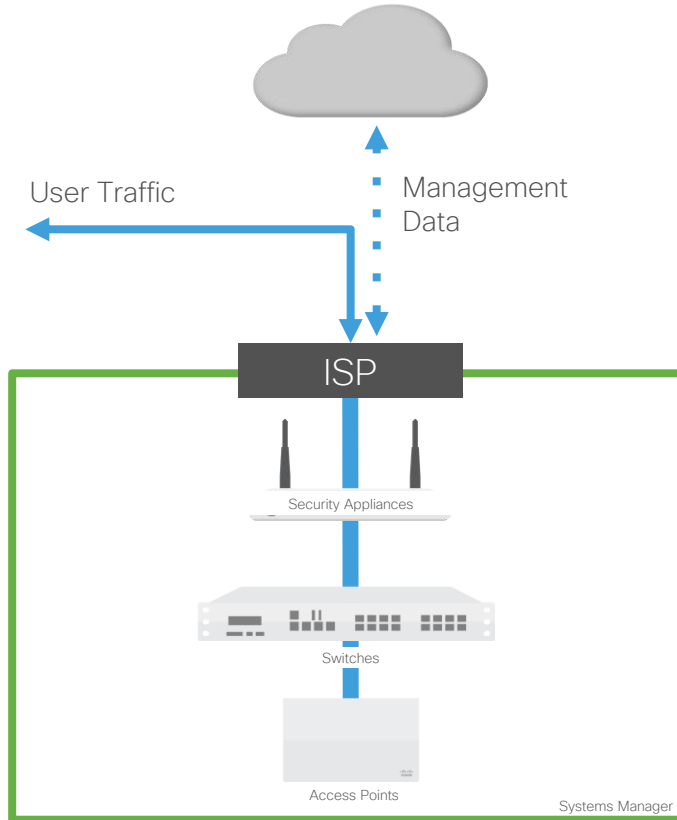
# SD-Access Wireless: true integration in Fabric



- CAPWAP Control Plane, VXLAN Data plane
- All integrated in Fabric, SD-Access advantages
- Requires software upgrade (8.5+)
- Optimized for 802.11ac Wave 2 and 11ax APs

- True wireless integration with Fabric
- Provides all the advantages of SDA for wireless clients:
  - Full automation with Cisco DNA Center
  - Hierarchical segmentation (VRF and SGT)
  - Same policy as wired
  - Distributed Data Plane with no drawbacks
  - Optimized traffic path for Guest
- Recommended option

# Cloud Architecture - Meraki



## Intuitive

- Simple browser-based dashboard
- Cloud-hosted centralized management platform

## Scalable

- Unlimited throughput, no bottlenecks
- Add devices or sites in minutes

## Reliable

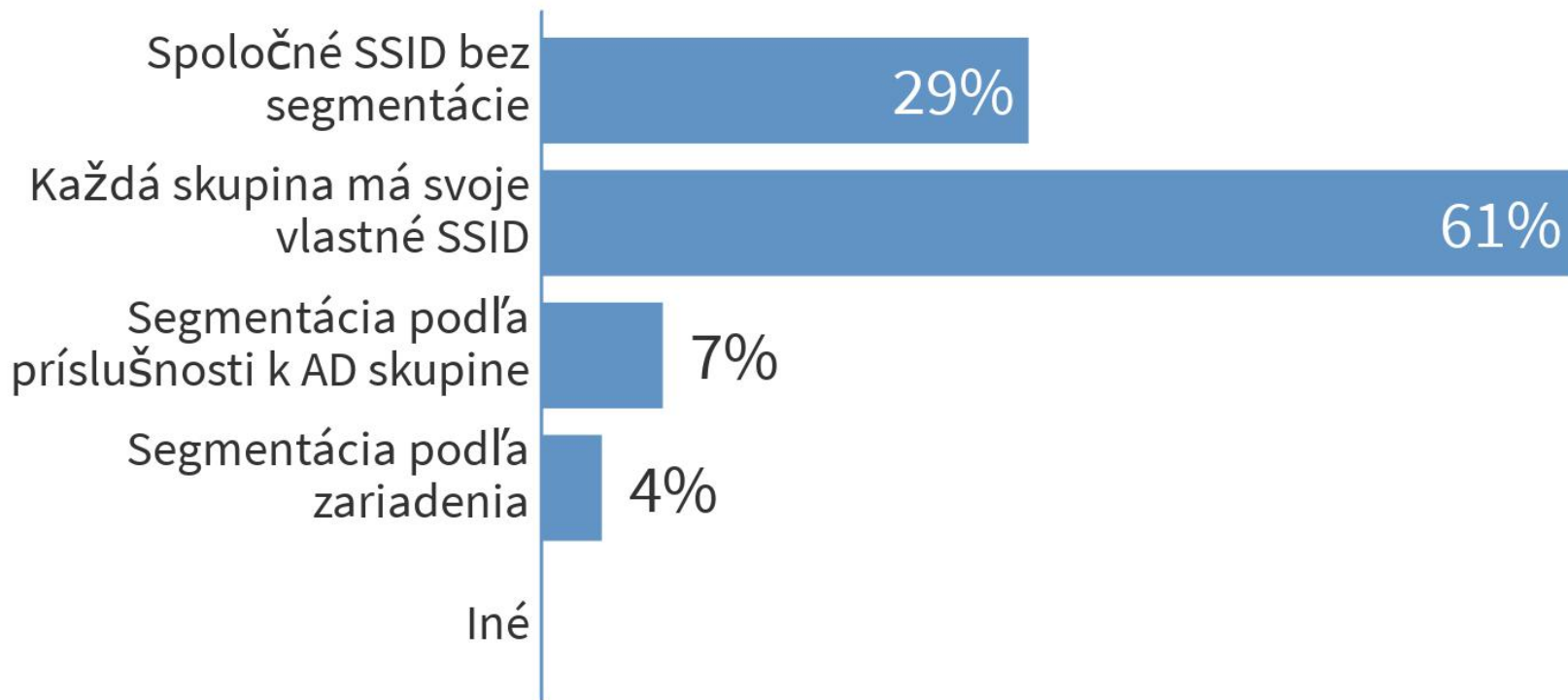
- Highly available cloud with multiple data centers
- Network functions even if connection to cloud is interrupted

## Secure

- No user traffic passes through Meraki cloud
- HIPAA / PCI-compliant network (level 1 certified), GDPR

Reliability and security information at  
[meraki.cisco.com/trust](https://meraki.cisco.com/trust)

# Akým spôsobom segmentujete vašu wireless sieť?



# Authorisation

## Network Segmentation

### Static VLAN Assignment

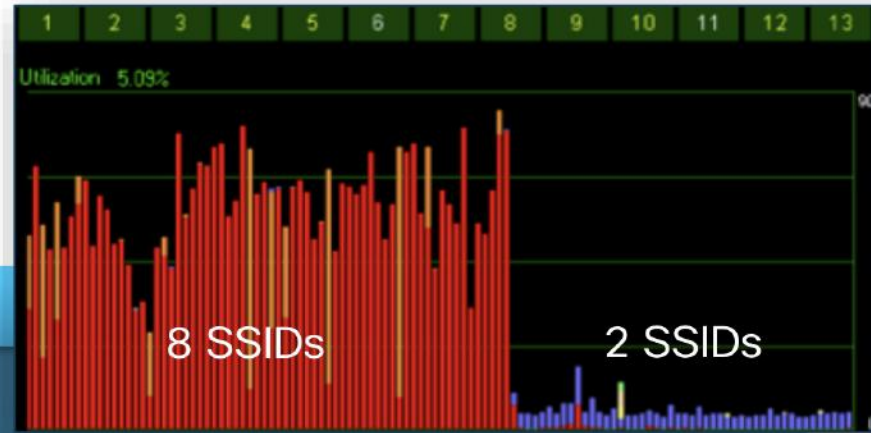
- VLAN based on SSID
- VLAN segregation based on security policy

### Dynamic VLAN Assignment

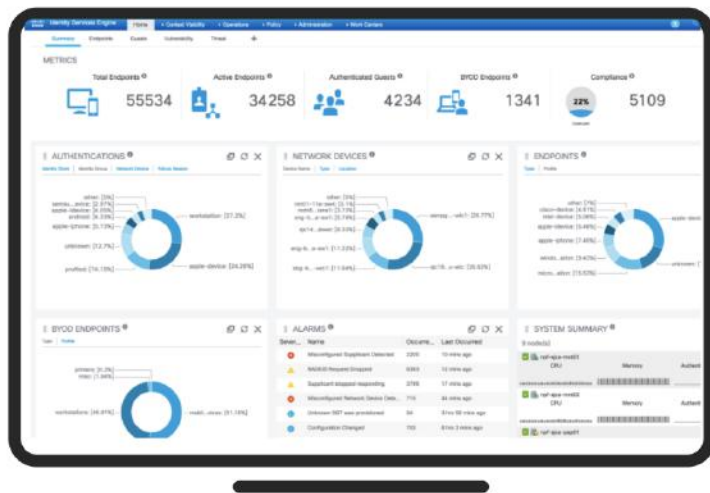
- VLAN based on authentication credentials
- VLAN segregation based on role

### Software Defined Access

- Security based on TrustSec Security Group Tags instead of source and destination addresses
- ACLs applied at the packet level

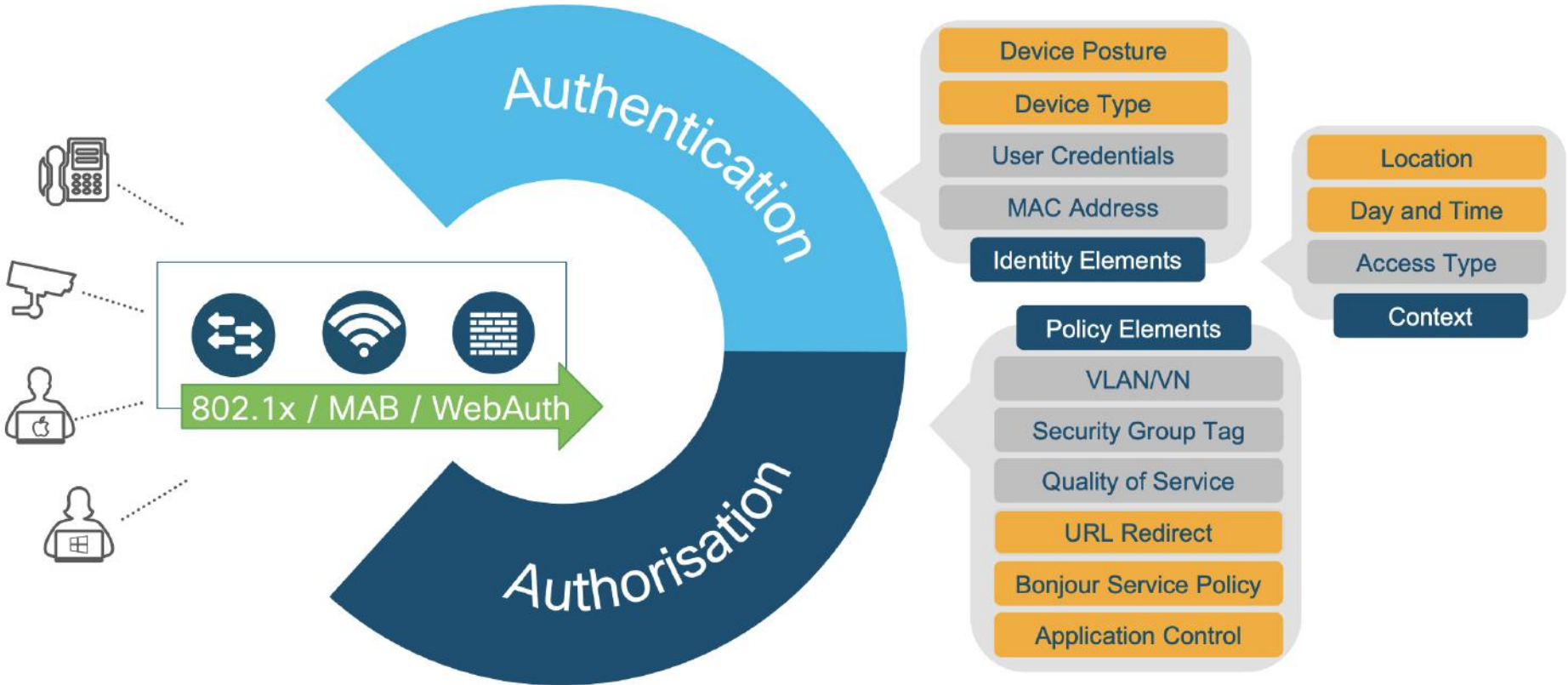


# Identity Services Engine



- MOBILITY**
- DEVICE ADMIN (TACACS+)**
- POSTURE**
- TRUSTSEC**
- SD-ACCESS**

# Authentication and Authorisation



# Wireless control access options

Complex PSK	Use longer PSK (12 characters or longer with mix of character types)
Identity PSK	Can limit sharing PSK between users
Limit access	Use segmentation; VLAN, ACL, SGT, IPSK p2p blocking, User Defined Network
WPA3-SAE	Consider WPA3 - Simultaneous Authentication of Equals (SAE), but understand its limitation with transition mode
WPA-Enterprise	Consider 802.1X, but understand how to deploy it securely

# Zhrnutie: WLAN Architektúry

- Cisco podporuje rozličné architektúry pre každý use-case:
  - Centralized
  - Flex-connect
  - SDA
  - Cloud
- Kľúčom k správne dizajnu wlan sietí je aj správny návrh bezpečnostných opatrení a segmentácia siete



# Jak vybírat komponenty pro síť Wi-Fi6?

## Část 1

Jaroslav Čížek

Systems Engineer – Enterprise Networking, Cisco Systems CZ

# WLAN Campus of the Future

Next-Gen Cisco Wireless Stack Designed for Wi-Fi 6



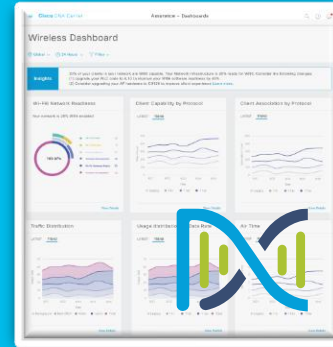
Wi-Fi 6  
Clients



Catalyst 9100  
Access Points



Catalyst 9800  
Wireless Controllers



DNA Automation &  
Assurance



DNA Spaces

Next Generation Cisco Wireless Stack – Resilient, Secure & Intelligent

Wi-Fi 6 Clients are here Today! ~300 Clients in Cisco Interop Testbed

DNA Assurance helps with Wi-Fi 6 Migration, Troubleshooting & Analysis

# Cisco + Device Manufacturers ecosystem

Cisco partners with major manufacturers to provide the best device experience



**SAMSUNG**



 Microsoft



## Best Wi-Fi 6 standards solution

- Client & network interoperability
- Maximize performance increase
- Consistent & Reliable
- Improved power efficiency

## Differentiation through standards +

- Client network analytics
- A client-centric view to DNA Center Assurance
- Improve Wi-Fi roaming
- Performance: 5x faster Wi-Fi & cellular handoff

## Open Partner Framework



- Enable partners to integrate with Cisco autonomously
- Standards + features across multiple client devices
- TTM Differentiation
- Grow Wi-Fi market

# Device ecosystem: Samsung Analytics

## Client classification

Device Type | SW-OS |  
Firmware version | Tx Power

## Client onboarding

**Client-side forensics:** Leverage client onboarding state machine failures to root cause issues

# SAMSUNG

## Client roaming

**Adaptive 11r :** Samsung clients support 11r on Adaptive 11r SSID  
**Client-side forensics:** Leverage client authentication failures while roaming

## Wi-Fi coverage\*

**Client RF View:** Use client's RF to draw coverage view

*\*Roadmap*

# Next-generation Cisco Catalyst access points

Ready for next-generation applications and devices

## Cisco® Catalyst® 9100

Increased capacity with Wi-Fi 6 technology



Delivering RF innovations

Extending Cisco's intent-based network

Expanding the device ecosystem



### Platform benefits



#### Resiliency

- Superior battery life for IoT and mobile devices
- Steady performance in demanding environments



#### Integrated security

- WPA3, Trustworthy systems
- Multi-lingual AP with RF snapshots

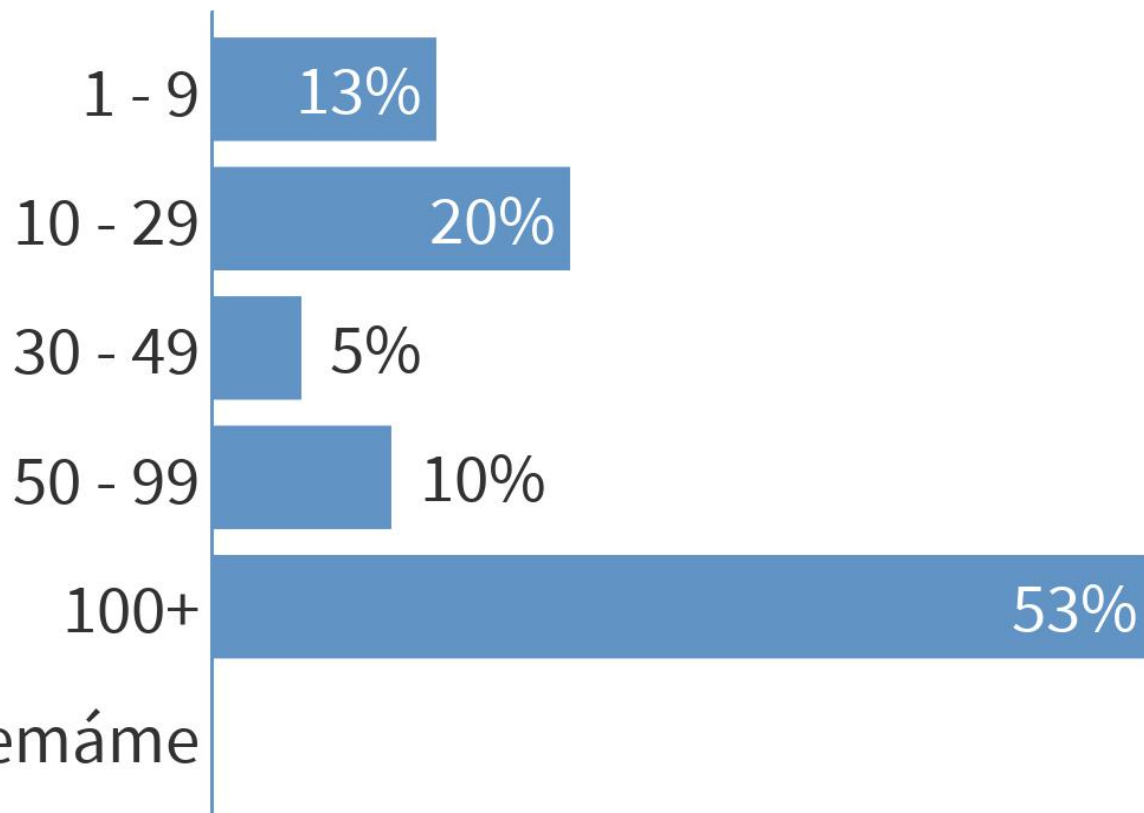


#### Intelligent

- Analytics for iOS and enhanced Cisco DNA Assurance
- Container support to host IOT applications

950 000 Cisco Wi-Fi6 APs shipped!!!

# Kolik AP ve vaší firmě provozujete?



Žádná oficiální AP nemáme

# New Cisco Catalyst 9100 Series Access Points

Purpose built for Wi-Fi 6

Ideal for small to medium deployments

Mission critical

Best in Class



9105AX

- 2x2 + 2x2
- MU-MIMO, OFDMA
- Spectrum Intelligence
- IoT ready
- 1 x 2.5 mGig (WP)



9115AX | 9117AX

- 4x4 + 4x4 | 8x8 + 4x4
- MU-MIMO, OFDMA (only DL)
- Spectrum intelligence
- 1 x 5 mGig



Powered by  
Cisco RF ASIC

9120AX

- 4x4 + 4x4
- Cisco RF ASIC
- Dual 5GHz, HDX
- IoT ready
- Application Hosting
- 1 x 2.5 mGig



Powered by  
Cisco RF ASIC

9130AX

- 8x8 + 4x4 or 4x4 + 4x4 + 4x4
- Tri-radio (Dual 5GHz + 2.4GHz)
- Cisco RF ASIC
- Decrypted data packet iCAP
- IoT ready
- Application Hosting
- 8 port Smart Antennas
- 1 x 5 mGig

Cisco DNA Assurance  
with iCAP

Bluetooth 5

USB

Integrated or external  
antenna SKUs

# Cisco Wireless Innovation in Catalyst APs

## IOx Framework

- Fully automated deployment
- Cisco & Third-Party APPs
- BLE GW and IoT GW

Container APPs



## Optimize Wi-Fi connectivity



- RF ASIC offloads off-channel scanning
- Up to **25%** better client performance
  - Benefits ALL Wi-Fi clients

Cisco RF ASIC



## Going Beyond Wi-Fi

- Cisco "IP" for better scheduler
- Device Manufacturers Partnership (Apple, Intel, Samsung)

State of the Art RF Design



## Deep network Insights



- Dedicated scanning radio
- Feed data to **ML/AI** to the Cloud
- Cisco Intelligent Capture (**iCAP**)

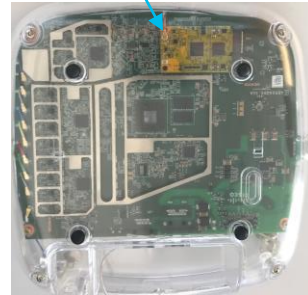


# 9120 and 9130 APs powered by Cisco RF ASIC

Superior analytics and security for mission critical deployments

Custom ASIC-based Software Defined Radio module  
For Full time Wireless Monitoring and Analytics.

Cisco RF ASIC



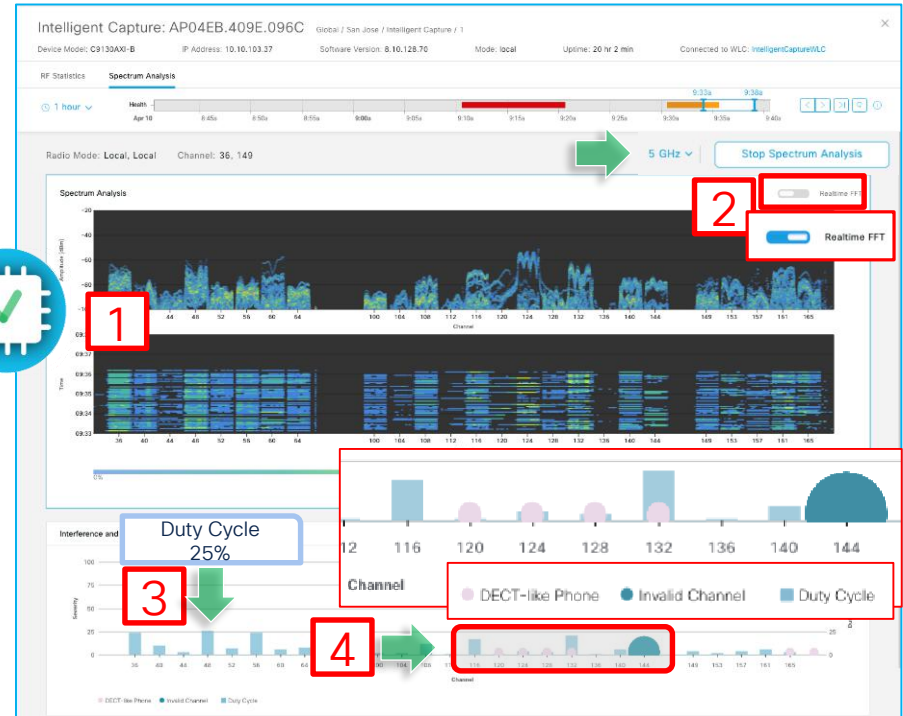
Zero-Wait DFS*	Dual Filter DFS	Clean Air	Off-channel RRM	FastLocate w/o Performance Impact	aWIPS/ Rogue Detection
<ul style="list-style-type: none"><li>Remove 60s scan delay</li><li>High Density Area, Port Authorities</li></ul>	<ul style="list-style-type: none"><li>Concurrent Dual DFS detection using two discrete chipset</li><li>Any High-Density Area</li></ul>	<ul style="list-style-type: none"><li>Interferer Detection and Impact Analysis</li><li>Interference mitigation</li></ul>	<ul style="list-style-type: none"><li>Dedicated Dual-Band Off-channel scanning</li><li>Improved Low Latency Application performance</li></ul>	<ul style="list-style-type: none"><li>Offload Faster location update using RF ASIC</li><li>Beneficial on any location-based service</li></ul>	<ul style="list-style-type: none"><li>Dedicate Security Radio Module</li><li>Mandatory feature for Enterprise Wireless Operation</li></ul>

\*Roadmap

# RF ASIC- Intelligent Capture, Spectrum View Cisco DNA Center Assurance



1. The Cisco RF ASIC allows viewing of the Full Band Selected, with no performance Impact
2. View the Live FFT by selecting Realtime FFT Mode
  - 60 Seconds of Live sweeps
3. Duty Cycle for every channel
4. CleanAir detected Interference also displayed, along with Percentage of Impact





# RF ASIC- Off Channel Scanning

## Spectrum Management Requires Data

- Off Channel Scanning - legacy AP (anything with 2 radio interfaces today)
  - All Channels must be scanned EVERY 180s within 3 Minutes
  - Dwell time is 50 ms, 10 ms for channel change = 60 ms off channel
  - 180s / 25 Channels = off channel dwell every 7.2s
- Off Channel Scanning for WSSI/WSM module and 4800 AP
  - Continuous cycle 1200 ms Dwell across 2.4 and 5 GHz
  - Supports RRM, aWIPS/WIDS, Rogue, FastLocate, CleanAir
  - Serving Radio still required for NDP\* Tx off channel as the module/third radio has no active transmitter

**Catalyst AP with RF ASIC:  
All the above!**

Plus: Better radios, Custom ASIC, Tx for NDP, and more...



\*Neighbor Discovery Protocol

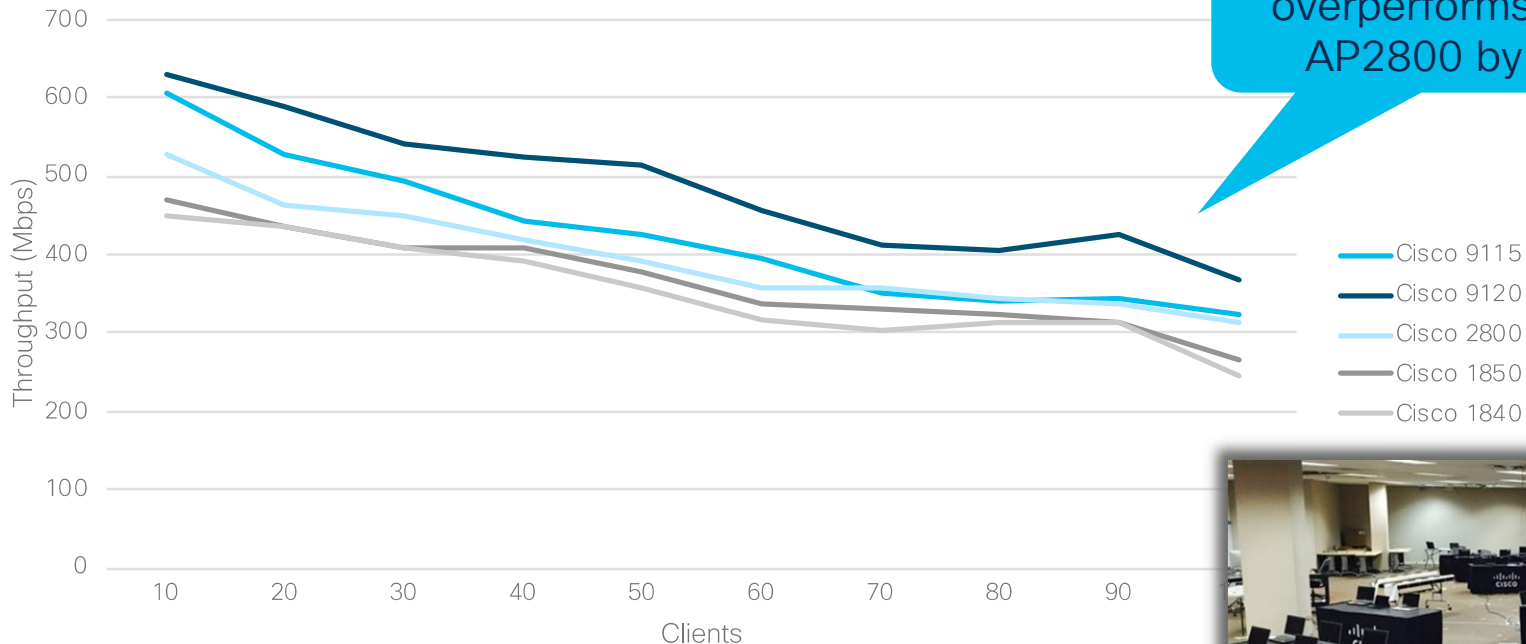
# High-Density Client Test- Results

## Cisco Wi-Fi 6 vs Wi-Fi 5 APs

OffChannel RRM



Multi-Client Performance



Cisco 9120AX overperforms Cisco AP2800 by 25%

Cisco 9100 series APs have clear advantage over Cisco Wave 2/Wi-Fi 5 APs

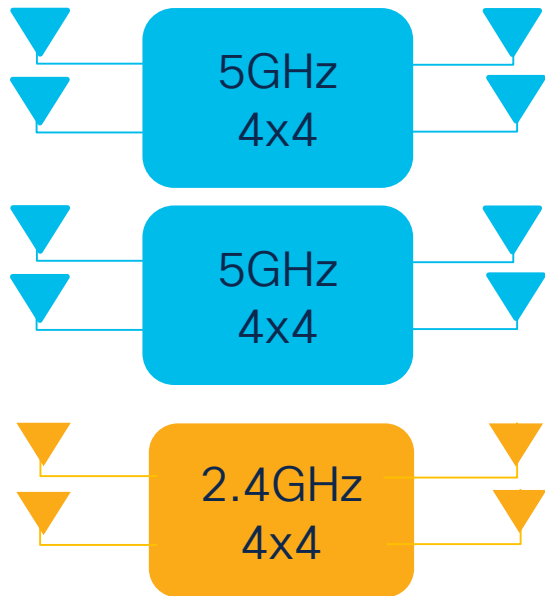


# Cisco AP 9130 - Tri-Radio for scale and capacity

## Tri-Radio or 8x8

### Why Tri-Radio?

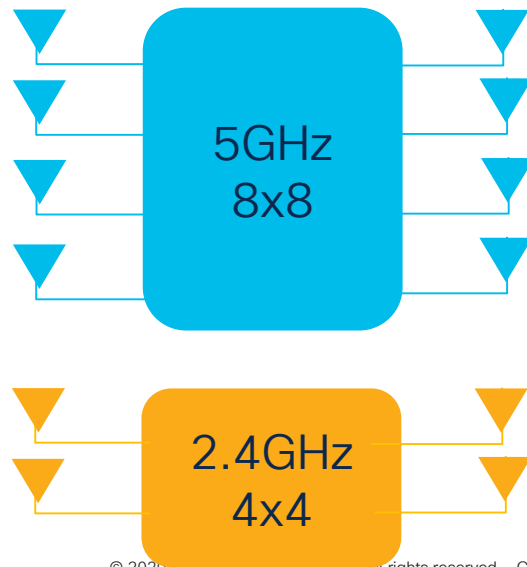
- ✓ 2 radios are better than 1, 3 is the best!
- ✓ More clients, greater performance across all Wi-Fi clients



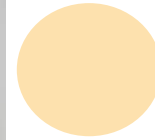
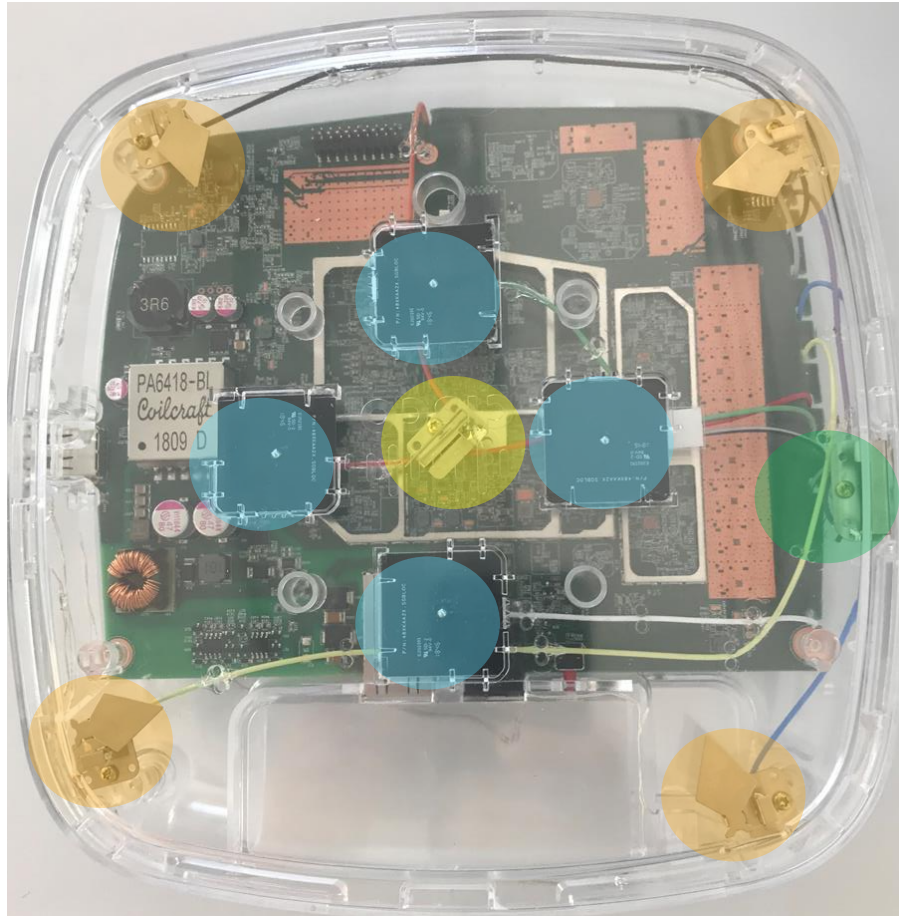
→  
Software  
enabled  
←

### Why 8x8?

- ✓ Higher throughput from a single radio
- ✓ Performance gains in a majority MU-MIMO client environment
- ✓ Better data-rate vs Range - better MRC



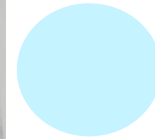
# Cisco AP 9130 - Antenna System



(4) Dual Band “Macro” antennas

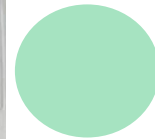
2.4 GHz @ 4 dBi

5.0 GHz @ 5 dBi



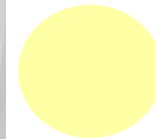
(4) 5 GHz “Meso” antennas

5 GHz @ 5 dBi



(1) IOT Antenna

2.4 GHz @ 2.5 dBi



(1) RF ASIC Antenna

2.4 GHz @ 4.5 dBi

5.0 GHz @ 5 dBi



# Catalyst 9100 Series Flexible power options:

	AP Model	Power source	Power Type	2.4 GHz Radio	5 GHz Radio	Link Speed	USB	Power Draw
9130	C9130AXI / C9130AXE	802.3at (PoE+)	PoE+	4x4	8x8	5G	OFF	25.5W
	C9130AXI	802.3at	PoE+	4x4	4x4	5G	ON	25.4W
	C9130AXI / C9130AXE	802.3bt (UPoE)	UPoE	4x4	8x8	5G	ON	30.5W
	C9130AXI / C9130AXE	802.3af	PoE	1x1	1x1	1G	OFF	13.4W
9120	C9120AXI / C9120AXE	802.3at	PoE+	4x4	4x4	2.5G	ON	25.5W
	C9120AXI / C9120AXE	802.3af	PoE	1x1	1x1	1G	OFF	13.4 W
	C9120AXI / C9120AXE	802.3af	PoE	2x2	N	1G	OFF	13.4 W
	C9120AXI / C9120AXE	802.3af	PoE	N	2x2	1G	OFF	13.4 W
9115	C9115AXI / C9115AXE	802.3at	PoE+	4x4	4x4	2.5G	ON	20.4W
	C9115AXI / C9115AXE	802.3af	PoE	2x2	2x2	1G	OFF	15.4W
9117	C9117AXI	802.3bt	UPoE	4x4	8x8	5G	ON	28.9W
	C9117AXI	802.3at	PoE+	4x4	8x8	5G	OFF*	25.4W
	C9117AXI	802.3af	PoE	2x2	2x2	2.5G	OFF	13.5W

\* If USB is enabled 5GHz will be reduced to 4x4

# What if I don't have any Wi-Fi 6 clients?



- Catalyst APs are **fully backward compatible** for legacy clients.
- All Clients experience improvement because of:
  - RF ASIC on 9120 & 9130 will improve performance with **off-channel scanning** feature.
  - C9130 is a **tri-radio** AP allowing for dual 5 GHz + 2.4G.
- Mixture of Wi-Fi 6 and legacy clients are fine – but significant improvements are realized when Wi-Fi 6 clients reach +30%

# Shrnutí - WLAN klienti, Cisco AP C91xx

- Cisco má úzké partnerství se všemi většími výrobci klientských chipsetů a zařízení – spolupráce při vývoji, testování
- Nadstavbové funkce s Applem a Samsungem – 802.11r/FT rychlý roaming, analytika / info o klientech, RF pohled klienta, QoS
- Cisco Catalyst AP C9105/9115/9120/9130 – nová generace Wi-Fi6 AP, vyšší výkon pro stávající i budoucí Wi-Fi6 klienty
- Cisco AP inovace a vlastnosti:
  - RF ASIC, iCap, Dual 5GHz (vč. externích antén), příprava pro IoT
  - Trustworthy, dostatečně dimenzovaný HW (CPU, RAM), nízká spotřeba, relativně kompaktní a hezký design, zachovávají se původní úchyty AP



# Jak vybírat komponenty pro síť Wi-Fi6?

## Část 2

Milan Rášo

Systems Engineer – Enterprise Networking, Cisco Systems SK

# Why Catalyst 9800?



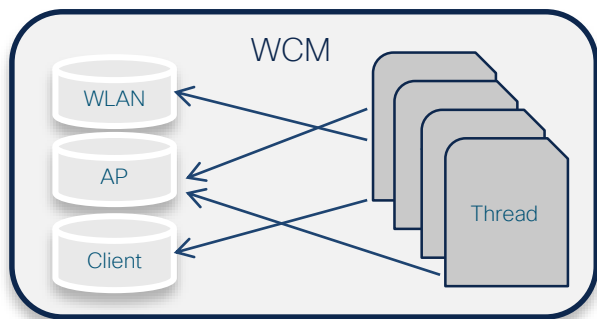
- Modular, highly available, scalable, multi-process operating system: **IOS XE**
- **Next Gen Resiliency**: Stateful Switchover, In Service Software, Rolling AP Upgrade, Patching
- Fully **Programmable**
- **Deploy Anywhere** with the model, the scale and performance of your choice

# Cisco Catalyst 9800 – Next Gen Software

Previous software architecture

vs.

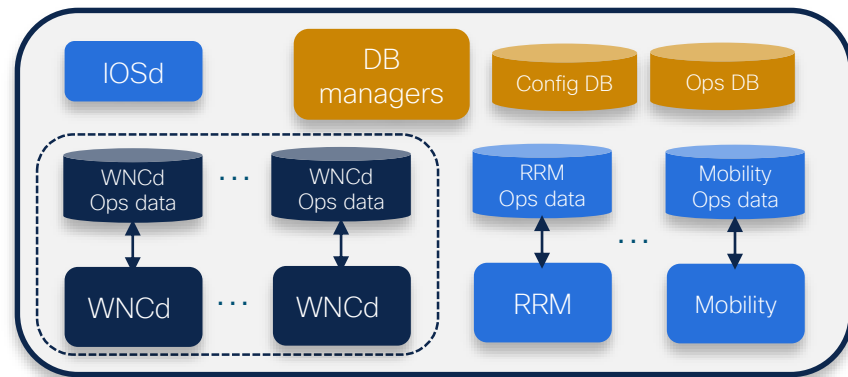
Catalyst Wireless Controller



High level view

Single process software architecture

- Wireless Controller Manager (WCM)
- 30+ threads
- Data contention cross threads
- Single memory space
- Single fault domain



High level view

Multi-process software architecture

- Processes are single threaded, non-blocking,
- New Wireless Network Controller process (WNCd).
- Multiple WNCd for horizontal scale
- No single fault domain (e.g. memory separation)
- Data model driven & data externalization
- Process patchability & restartability
- Independent boot\*

\* System capable, roadmap item

# Cisco Catalyst 9800 Series Wireless Controllers



Cisco DNA Center

Translate business intent into network policy and capture actionable insights with Cisco DNA Center



Cisco® Catalyst® 9800-80



Cisco Catalyst 9800-40



Cisco Catalyst 9800-L

Cisco Catalyst 9800-CL for cloud



Cisco Catalyst 9800 embedded wireless for Cisco Catalyst 9000 switch family and 9100 access points

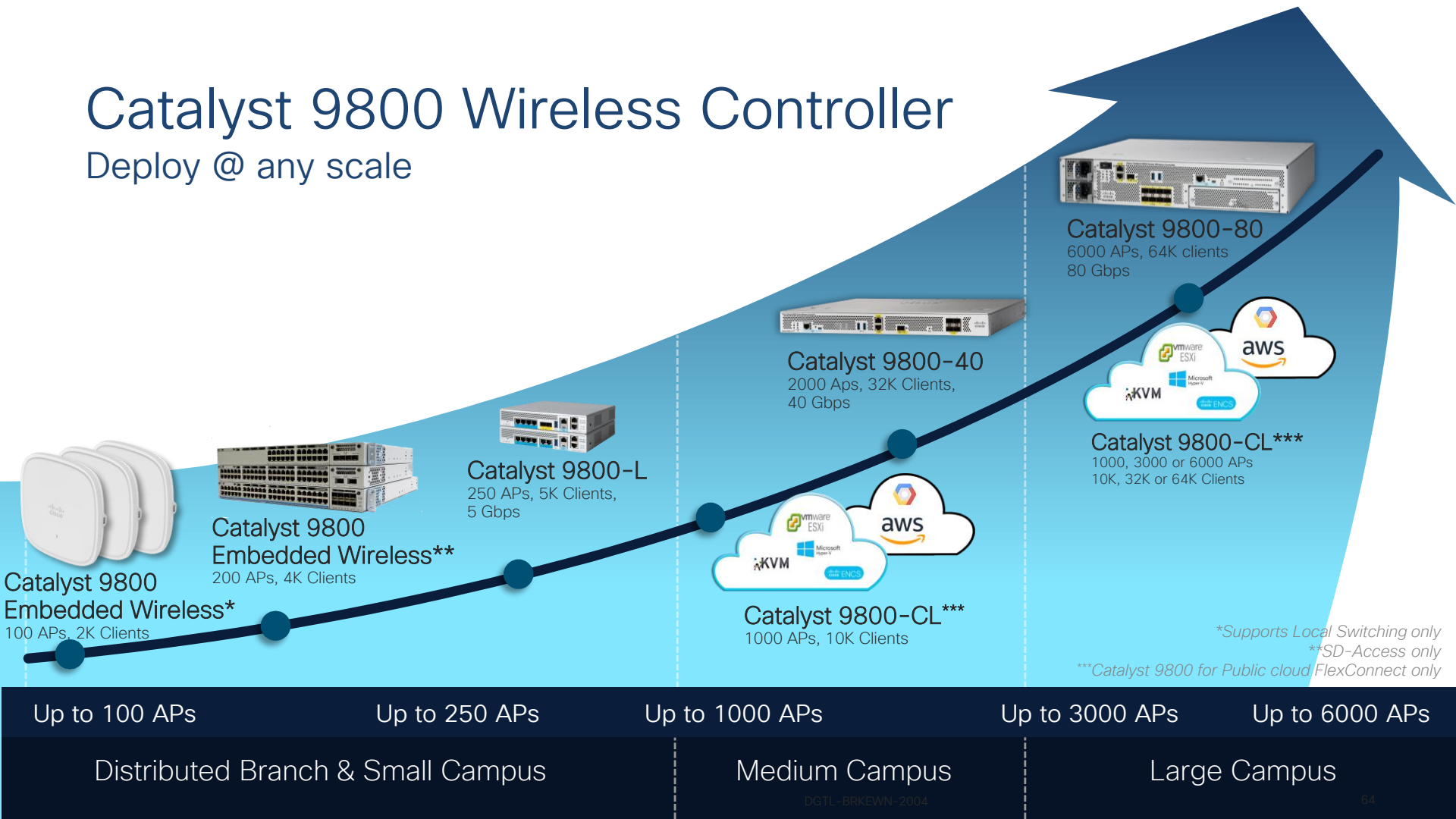
Cisco Aironet® and Catalyst access points

Works with Aironet 802.11ac Wave 1 and Wave 2 and 802.11ax Cisco Catalyst 9100 access points



# Catalyst 9800 Wireless Controller

Deploy @ any scale



**Catalyst 9800 Embedded Wireless\***  
100 APs, 2K Clients



**Catalyst 9800 Embedded Wireless\*\***  
200 APs, 4K Clients



**Catalyst 9800-L**  
250 APs, 5K Clients, 5 Gbps



**Catalyst 9800-40**  
2000 Aps, 32K Clients, 40 Gbps



**Catalyst 9800-CL\*\*\***  
1000 APs, 10K Clients



**Catalyst 9800-80**  
6000 APs, 64K clients 80 Gbps



**Catalyst 9800-CL\*\*\***  
1000, 3000 or 6000 APs  
10K, 32K or 64K Clients

*\*Supports Local Switching only*

*\*\*SD-Access only*

*\*\*\*Catalyst 9800 for Public cloud FlexConnect only*

Up to 100 APs

Up to 250 APs

Up to 1000 APs

Up to 3000 APs

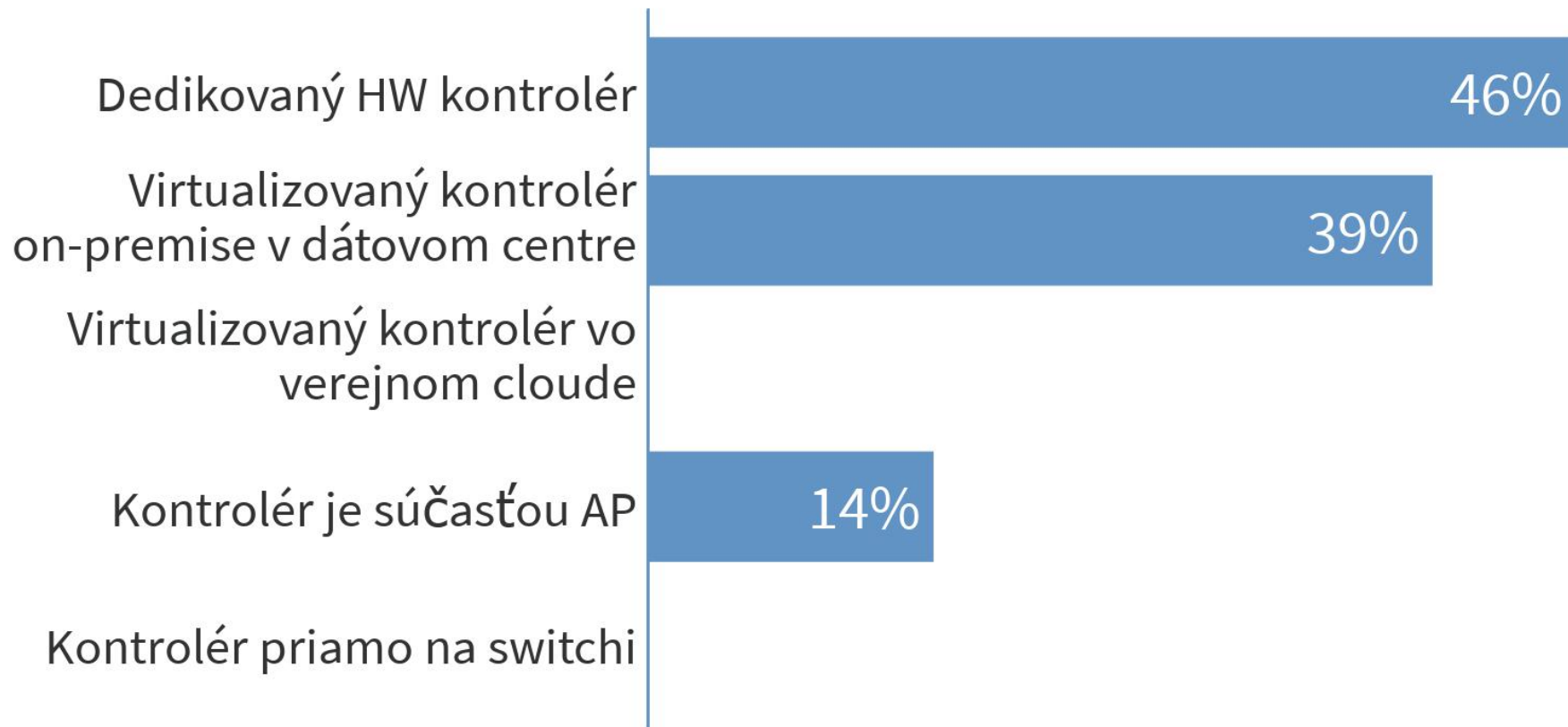
Up to 6000 APs

Distributed Branch & Small Campus

Medium Campus

Large Campus

# Aký spôsob nasadenia wireless kontroléra preferujete?

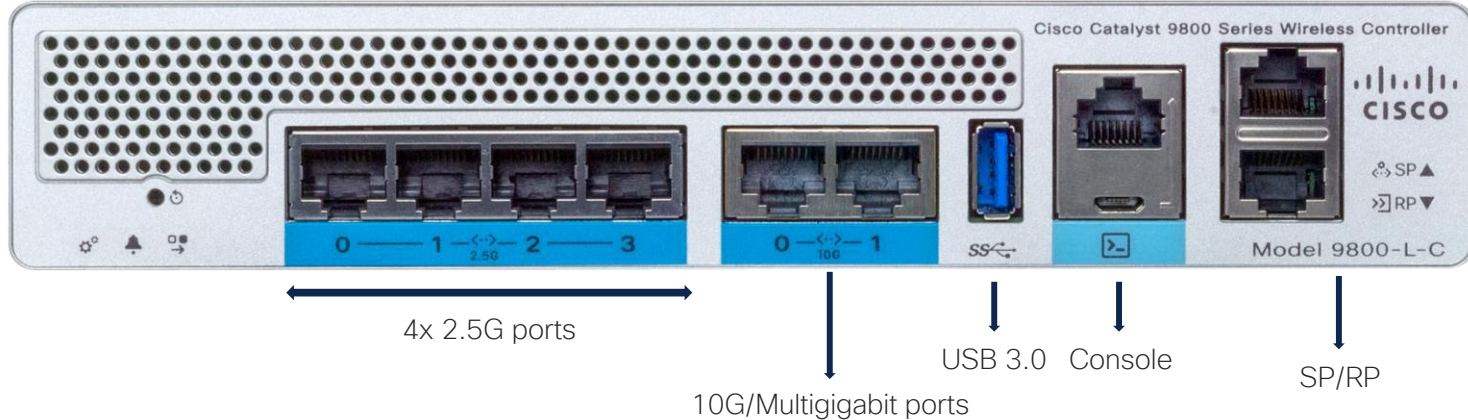


# 9800-L: Industry's first fixed wireless controller with seamless software updates

Up to 250 APs

Up to 5,000 clients

5 Gbps



Fully programmable multicore network processor

Support for NetFlow, AVC, and ETA

# Cisco Catalyst 9800 embedded wireless on the 9000 switch platform



Install Cisco Catalyst 9800 embedded wireless on your existing branch infrastructure



## SD-Access

Optimized for SD-Access with an always-on fabric

## Cisco Catalyst 9300

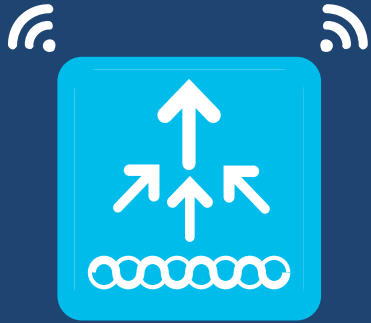
Supported on Cisco Catalyst 9300 Series Switches

## Up to 4000 clients

Supports up to 200 APs and 4000 clients

# Embedded wireless controller on Cisco Catalyst 9100

Ready for enterprise deployments



Runs 9800 Series Cisco IOS® XE wireless controller on Cisco® Catalyst® access points

Modern OS, scalable, open and programmable, supports telemetry



Supports advanced enterprise feature set

HA, SMU, adaptive wireless IPS (aWIPS), Cisco Umbrella™, NetFlow, ICAP



Flexible management options

Use mobile app, WebUI, and Cisco DNA Center to deploy, manage, and monitor



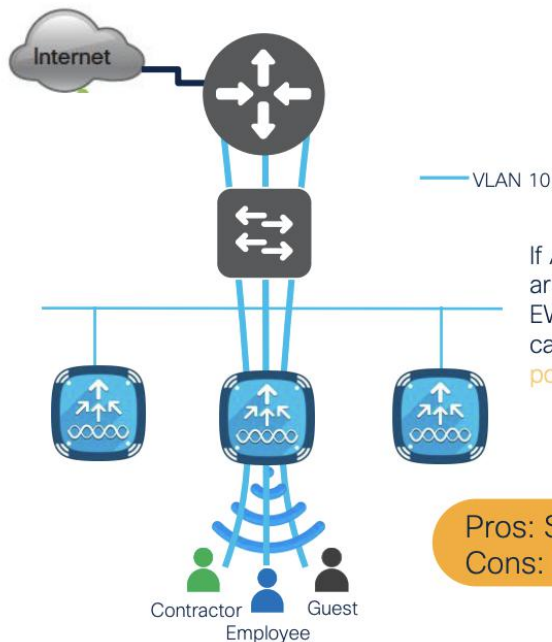
Investment protection

Migrate access points to controller for more than 100 access points

# Deploying Cisco Embedded Wireless Controller

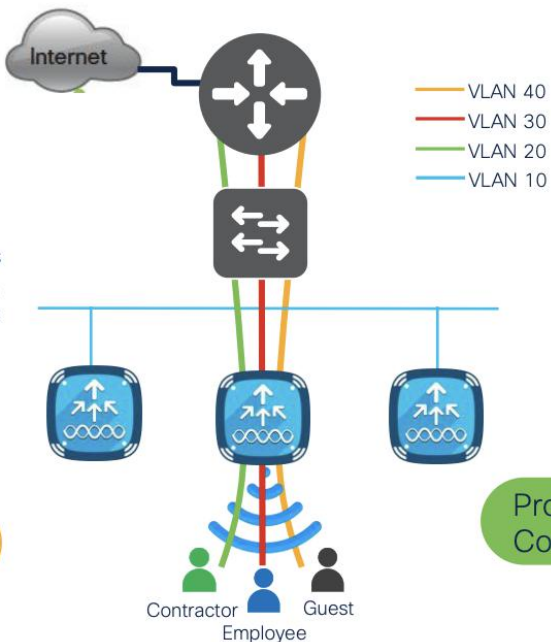
## Embedded Wireless Controller for Catalyst 9100 Series

- EWC capable Access Points can be connected to an **access port** or a **trunk port** on the switch depending on the deployment method
  - Management traffic is always untagged



If Access Points and WLANs are all on the same network, EWC capable Access Points can connect to an **access port** on the switch port.

Pros: Simple  
Cons: Less Flexible

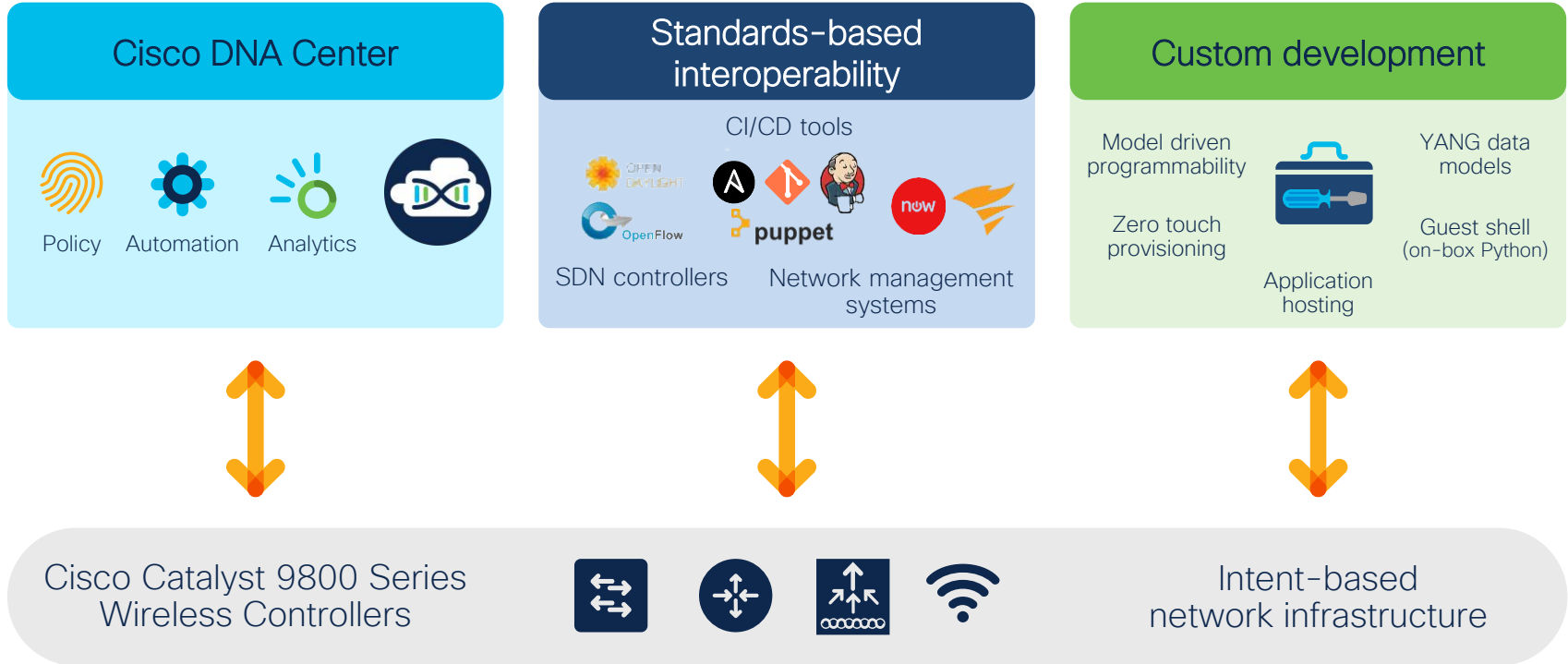


VLAN 40  
VLAN 30  
VLAN 20  
VLAN 10

If Access Points and WLANs are all on different VLANs, EWC capable Access Points will connect to a **trunk port** on the switch and traffic for individual WLANs will be switched locally.

Pros: Flexible, Secure  
Cons: More configuration

# Flexible management options with Cisco Catalyst 9800 Series Wireless Controllers



# Cisco Catalyst 9800 – Next Gen Wireless Controller

## Benefits



### Cisco Catalyst 9800 Series Wireless Controllers

*Powered by Cisco IOS® XE  
Open and programmable*

#### Resilient



- Zero downtime with software updates and upgrades
  - WLC SMU
  - AP Service and Device Pack
  - Intelligent Rolling AP Upgrade
- In Service Software upgrade (ISSU)
- RF based Rolling AP upgrades

#### Secure



- Automated macro and micro segmentation with SD-Access
- Detect encrypted threats with Encrypted Traffic Analytics (ETA)
- WPA3, Trustworthy systems, etc.

#### Intelligent

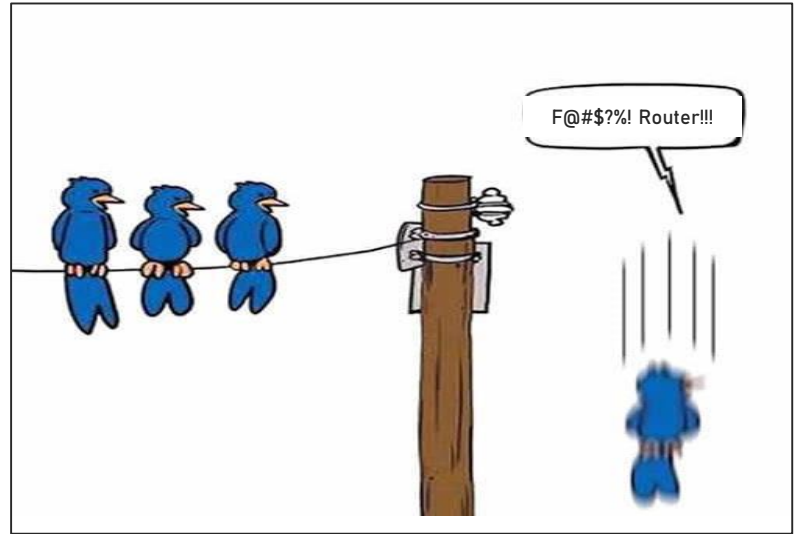


- Programmable network processor and IOx infra support
- Deploy in infrastructure of choice and cloud of choice
- Enhanced analytics with Cisco DNA
- Enables advanced solutions like Cisco User Defined Network (UDN)

Leadership in Wireless networking

Extending Cisco's  
intent-based network

Innovation Beyond  
the Standard



# Always on in planned and unplanned scenarios

## Unplanned events

Device and network interruptions

- Stateful switchover with an active standby
- N+1 redundancy for always-on network, services, and clients

## Infrastructure updates

Software maintenance and AP updates

- Seamless software updates for wireless controllers and APs
- AP device pack and flexible per-site updates contain impact area

## Software image upgrades

Wireless controller image upgrades

- N+1 rolling AP upgrades help ensure seamless client connectivity
- Radio Resource Management automates group creation



### Contain impact within release

Fixes for defects and security issues without the need to requalify a new release



### Faster resolution of critical issues

Provide fixes to critical issues found in network devices that are time-sensitive

# Unplanned Events

## Catalyst 9800 High Availability



### Always on **Network**

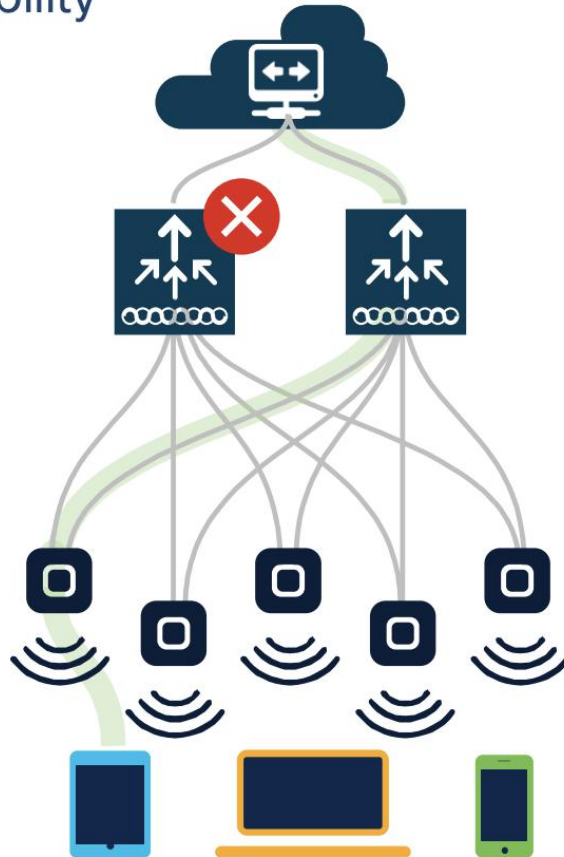
APs continue to stay associated

### Always on **Services**

Uninterrupted voice, video and data services

### Always on **Clients**

Users and end-points continue to stay connected



### How it Works

- ✓ Upstream device and network interruptions trigger a switchover to maintain end-point connectivity
- ✓ Hot standby controller takes over in case of failure of an active controller
- ✓ Seamless connectivity with Stateful Switchover (SSO) for end-points

# End-to-End Wireless Network Security



Air



Devices



Users



Rogue intrusion detection and prevention - WIPS



Enhanced threat detection with ETA



Seamless BYOD onboarding with ISE



Standards compliance with WPA3

- Enhanced security on open Wi-Fi
- Robust password protection
- Superior data protection
- Seamless customer migration



Secure device management with MPSK and iPSK



Identity-Based segmentation with SD-Access

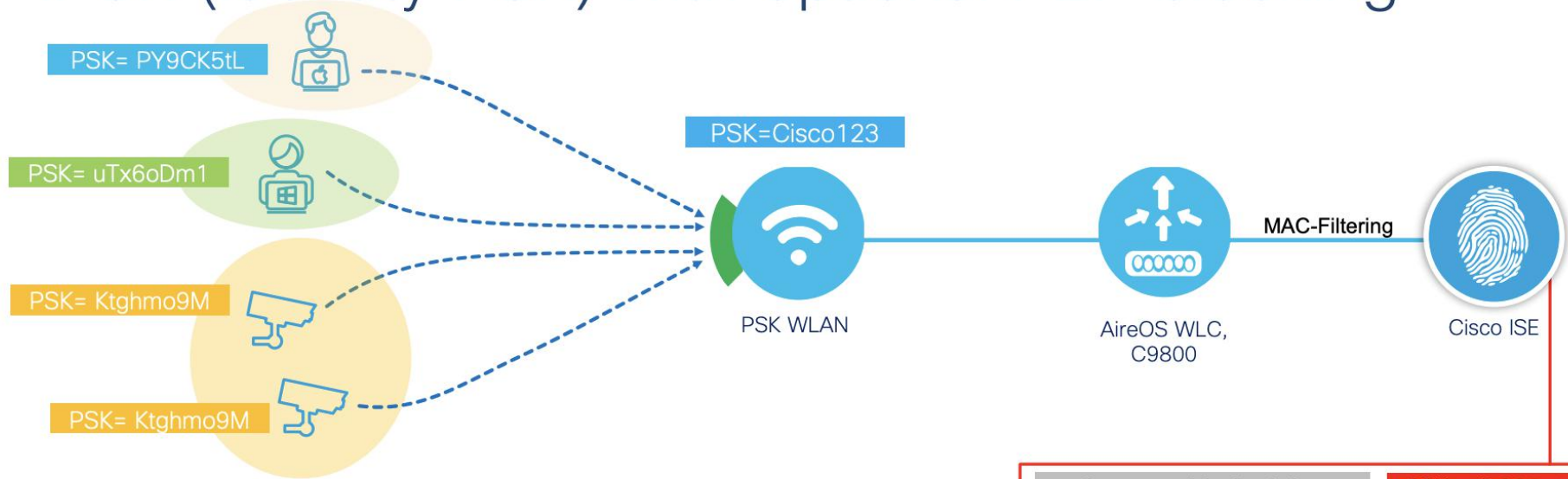
# Secure device management with MPSK and iPSK WLAN Endpoint Population



	Guest	IoT (Internet of Things)	BYOD (Bring Your Own Device)	Employee Device (Organization Provided)
Level of Trust	None	Low	Medium	High
Control	Low	Low	Medium	High
Access Requirement	Internet	Internet and/or IoT Controller	Internet and/or Limited Internal	Full Access
Authentication method	Open, WebAuth	<b>PSK</b>	<b>PSK</b> , 802.1X	802.1X

# Secure device management with MPSK and iPSK

## iPSK (identity PSK) with optional P2P blocking



- Each endpoints associate to the single WLAN with it's own PSK value, Endpoints with same PSK value defines segmented network
- ISE provides mapping of MAC address to PSK
- Supported with AireOS 8.5, C9800 16.10.1, Mobility Express AP 8.8MR2, Embedded WLC on Catalyst AP 16.12.2, Meraki MR 26.5
- P2P blocking requires AireOS Controller running 8.8 or C9800 Running 17.1

Group == Medical Cart	PSK= zD235o1M
Profile == Smart TV	PSK= 8GB10vaq
MAC= 20:C9:D0:2B:80:F7	PSK= PY9CK5tL
MAC= 9C:3D:CF:4A:72:4D	PSK= uTx6oDm1
MAC= 50:C7:BF:BA:D3:23	PSK= Ktghmo9M
MAC= 50:C7:BF:BA:D9:75	PSK= Ktghmo9M
⋮	⋮

# Zhrnutie: Catalyst 9800

- Moderný kontrolér s modulárnym operačným systémom IOS XE
  - Always on vysoká dostupnosť
  - Flexibilita – možnosť nasadenia do každého prostredia (HW, On-prem DC, cloud)
  - Možnosť štandardných aj open source manažment riešení
- Bezpečnosť na prvom mieste
  - WPA3, ETA, Secure BYOD, segmentácia SDA



Připravte si infrastrukturu na novou realitu

Bezdrátové sítě | 23. 6. 2020

# Shrnutí úvodní části



You make **possible**



# Připravte si infrastrukturu na novou realitu

Bezdrátové sítě | 23. 6. 2020



Zuzana Švecová

Architecture Lead,  
Cisco Systems CZ & SK



You make **possible**



Připravte si infrastrukturu  
na novou realitu

Bezdrátové sítě | 23. 6. 2020

# Program



You make **possible**

## Blok 1

9:30	Rozhovor s expertem – Petr Krčmář, šéfredaktor root.cz Losování soutěže root.cz	Pavel Křížanovský
9:45	Poznejte možnosti Wi-Fi6 a WPA3	Jarda Čížek
10:00	Jak se staví WLAN síť?	Milan Rášo
10:15	Jak vybírat komponenty pro síť Wi-Fi6? (část 1)	Jarda Čížek
10:30	Jak vybírat komponenty pro síť Wi-Fi6? (část 2)	Milan Rášo
10:45	Shrnutí úvodní části	

Přestávka

## Blok 2

10:55	Proč jsme přešli na Wi-Fi6 – zkušenost společnosti Teleplan	Pavel Křížanovský
11:05	Mějte Wi-Fi pod kontrolou – živé demo	Zdeněk Roubal, Jarda Čížek
11:15	Monitoring – analytika – integrace	Zdeněk Roubal
11:30	Návod: úspěšná migrace na Wi-Fi6	Jarda Čížek, Milan Rášo
11:45	Závěrečné shrnutí	
11:50	Otázky a odpovědi	
12:00	Závěr	

# Přestávka

Následuje:

Proč jsme přešli na Wi-Fi6?

Začínáme za

5:00 min

Připravte si infrastrukturu na novou realitu

Bezdrátové sítě

23. 6. | 9:30 – 12:00



You make **possible**



Připravte si infrastrukturu  
na novou realitu

Bezdrátové sítě | 23. 6. 2020

# Program



You make **possible**

## Blok 1

9:30	Rozhovor s expertem – Petr Krčmář, šéfredaktor root.cz Losování soutěže root.cz	<i>Pavel Křížanovský</i>
9:45	Poznejte možnosti Wi-Fi6 a WPA3	<i>Jarda Čížek</i>
10:00	Jak se staví WLAN síť?	<i>Milan Rášo</i>
10:15	Jak vybírat komponenty pro síť Wi-Fi6? (část 1)	<i>Jarda Čížek</i>
10:30	Jak vybírat komponenty pro síť Wi-Fi6? (část 2)	<i>Milan Rášo</i>
10:45	Shrnutí úvodní části	

Přestávka

## Blok 2

10:55	Proč jsme přešli na Wi-Fi6 - zkušenost společnosti Teleplan	<i>Pavel Křížanovský</i>
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11:50 Otázky a odpovědi

12:00 Závěr



# Připravte si infrastrukturu na novou realitu

Bezdrátové sítě | 23. 6. 2020

Michal Návorka

Senior Infrastructure & Security Engineer

Cisco CCIE DC & SEC & RS #47483

Teleplan



You make **possible**



# Proč jsme přešli na Wifi 6 ?

## Zkušenosti společnosti Teleplan

Michal Návorka

Senior Infrastructure & Security Engineer



# Připravte si infrastrukturu na novou realitu

Bezdrátové sítě | 23. 6. 2020



Zdeněk Roubal

Sales Specialist – Enterprise Networking,  
Cisco Systems CZ



You make **possible**



# Mějte Wi-Fi pod kontrolou

## Živé demo

Jaroslav Čížek, Zdeněk Roubal



# Monitoring – Analytika – Integrace

Zdeněk Roubal

Sales Specialist – Enterprise Networking, Cisco Systems CZ

# Flexible Management Options

## PI / DNA Center



Policy



Automation



Analytics

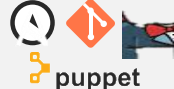


## Standards Based Interoperability

CI/CD Tools



SDN Controllers



puppet



NMS Systems

## Custom Development

Model Driven Programmability

Zero Touch Provisioning



App Hosting

YANG Data Models

Guest Shell (On Box Python)



Prime Infrastructure



Native Controller UI



Catalyst 9800  
Wireless Controllers



Intent-Based  
Network Infrastructure

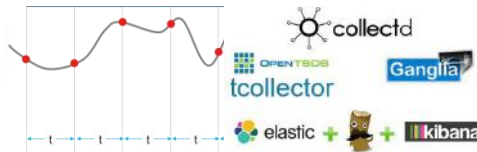
# Complete control of your Day 0-N operations with open and programmable APIs



Provisioning  
Automation



Model driven  
programmability



Model driven  
telemetry



Software image  
management

Day 0

Day 1

Day 2

Day N

Onboarding

Configuration

Monitoring

Optimization

Zero touch provisioning  
Plug and Play

YANG data models  
Configuration protocols,  
NETCONF, RESTCONF, ..

Streaming telemetry  
NETCONF, gRPC, gNMI

Guest shell  
(on-box Python)  
EEM Scripts

# Monitoring with IOS XE Model Driven Telemetry

Cisco IOS XE



CLI

...or with...

YANG



ANSIBLE

gNMI Dial-In  
NETCONF Dial-In

gRPC Dial-Out

**Receiver**  
Decodes to text



Telegraf

**Storage**  
Time Series Database

InfluxDB

**Monitoring  
and Visualizations**



Grafana



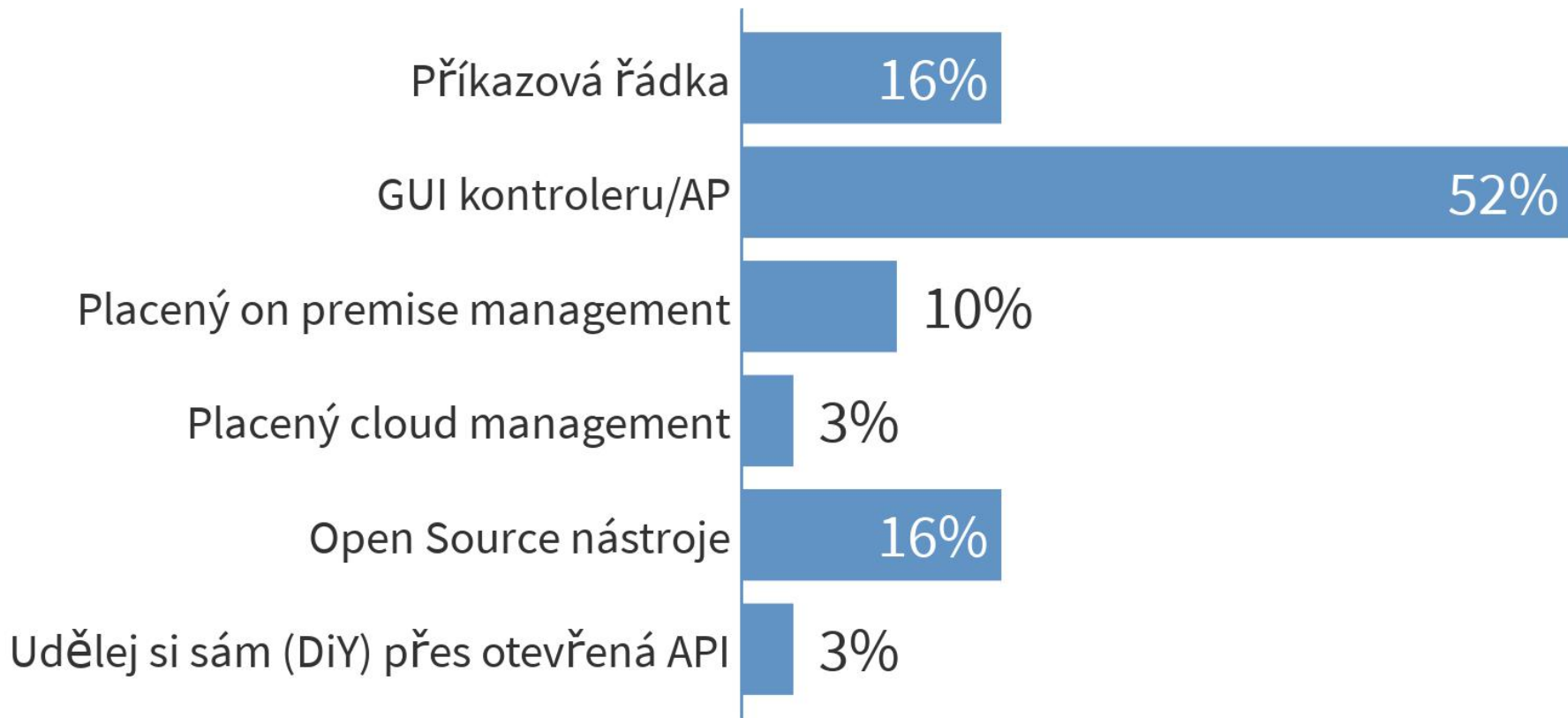
[https://hub.docker.com/r/jeremycohoe/tig\\_mdt](https://hub.docker.com/r/jeremycohoe/tig_mdt)

<https://github.com/jeremycohoe/cisco-ios-xe-mdt>

[https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/prog/configuration/171/b\\_171\\_programmability\\_cg.html](https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/prog/configuration/171/b_171_programmability_cg.html)



# Jaký způsob WiFi managementu preferujete?





## Cisco Prime Infrastructure

### Traditional Network Management

- Software Image Distribution
- Configuration Archive/Backup
- Templating for Automation
- Reporting
- Assurance
- Events
- Tons of data, but not enough insights
- Semi-closed system with predefined configurations



## Cisco DNA Center

### Intent base Network Management

- No events/alarms, but insights and impact analytics with Guided remediation
- Automation, day0, day1, day2
- Policy and segmentation control
- Software update (ITSM, Compliance)
- Network telemetry data collection
- Baselining over time, baseline against others
- No manual configuration required
- API and Business API

# Cisco DNA Center - Unified network management for enterprise wireless



Policy



Automation



Assurance



Unified experience



Abstracting network OS and unifying workflows (UX/API) across AireOS and Cisco® Catalyst® WLC

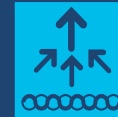
## Intent-based network infrastructure



Cisco Catalyst 9800 Series  
Wireless Controller



Cisco Catalyst and  
Aironet® access points



AireOS wireless  
controller

# Cisco DNA Wireless Assurance

## Troubleshooting Tool-kits for a Network operator



Streaming Telemetry



Intelligent Capture Auto PCAPs



Active Sensor Testing



iOS and Samsung Analytics



AI Anomaly Baselineing



AI Network Insight



Machine Reasoning

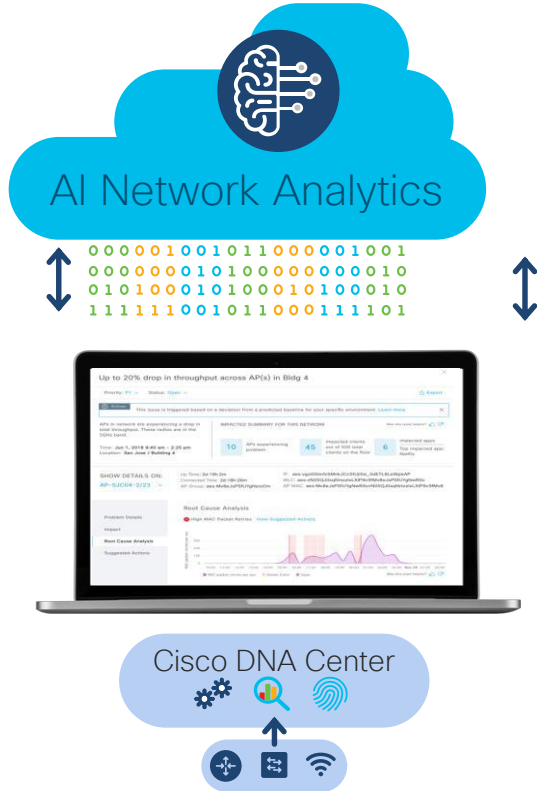
Active Sensor for Wireless Network SLA assessment



Aironet 1500, 1800, 2800, 3800, 4800, Catalyst 9xxx AP with Intelligent Capture



# Cisco AI Network Analytics



**Visibility: Personalized Baselineing**  
Intelligently define personalized "network normal" using unified global telemetry collected

**Insight: Intelligent Analysis**  
Increase signal-to-noise, improve issue relevancy, and accurately identify trends and root causes

**Action: Accelerated Remediation**  
Create automated resolution options for IT to act on based on machine reasoning algorithms

# Solving the Most common Wireless problems through AI/ML - Focus on Client Experience

## Wireless Onboarding

Wireless User Failed to Connect  
Wireless User took too long to Connect



Excessive Time

Excessive Failures

Excessive DHCP Time

Excessive DHCP Failures

Excessive AAA Time

Excessive AAA Failures

Excessive Assoc. Time

Excessive Assoc. Failures

## Application Experience

Wireless User's Application throughput is declining



Total Radio

Media Application Throughput

Cloud Application

Social Application Throughput

Analytics and Outlier Detection on

- Wi-Fi Onboarding Analytics
- Wi-Fi Radio Performance Analytics
- App Perf. Analytics on Wi-Fi network

# Readiness and Assurance for Wi-Fi 6

## Insights

7.41% of clients in the network are Wi-Fi 6 capable. 33.33% of your AP Infrastructure is Wi-Fi 6 ready.

Consider the following changes:

- (1) Upgrade your controller OS version to **AireOS 8.10MR3**, or **IOS-XE 17.3.1** to enjoy the benefits of a Wi-Fi 6 network.
- (2) Upgrade your AP hardware to the **Catalyst 9100** Wi-Fi 6 AP Series for a better client experience.

### Client Distribution by Capability

LATEST TREND

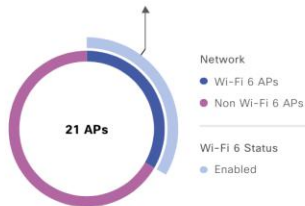
100% of Wi-Fi 6 clients are associated to a Wi-Fi 6 network



View Details

### Wi-Fi 6 Network Readiness

Your network is 33.33% Wi-Fi 6 enabled



View Details

### AP Distribution by Protocol

LATEST TREND

33.33% of APs are Wi-Fi 6 capable



View Details

### Wireless Airtime Efficiency *BETA*

LATEST TREND

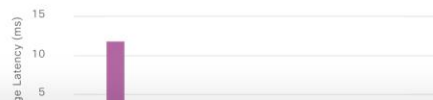
View: Voice



### Wireless Latency by Client Count *BETA*

LATEST TREND

View: Voice



# Next Gen Wireless Security on C9800 and DNAC

## Cisco DNA Center



## Cisco DNA Center Appliance



## Catalyst 9800 Wireless Controller



Global alarm consolidation: New centralized classification engine that reduces false positives



Threat prioritization: Curated view to highlight most relevant data and reduce data overload



Seamless signature upgrades\*: Add or upgrade threat signatures with zero downtime



Policy-based Quarantining\*: Automate threat resolution through Software Defined Access



CMX

or



DNA Spaces

Optional

# Cisco DNA Spaces

## Digitizing Spaces: People & Things



See

See what's happening at your spaces, how people and things behave

Act

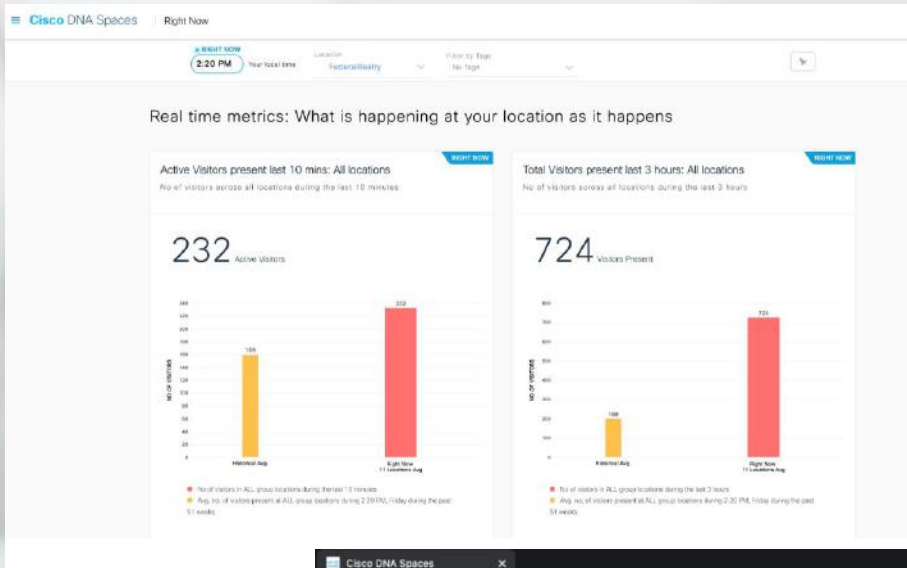
Leverage digitization tool kits to act on insights

Extend

Drive business outcomes with partner apps and enterprise extensions



Cisco Wireless Network :  
**Connectivity + Digitization**



Using the **Right Now App** on Cisco DNA Spaces.

You could create density rules to monitor the number of employees in buildings across campus.

Density rules can be created by device count (number of devices) and density (e.g., number of visitors per 25 m<sup>2</sup>)

Cisco DNA Spaces x

dnaspaces.io/right-now/density/create

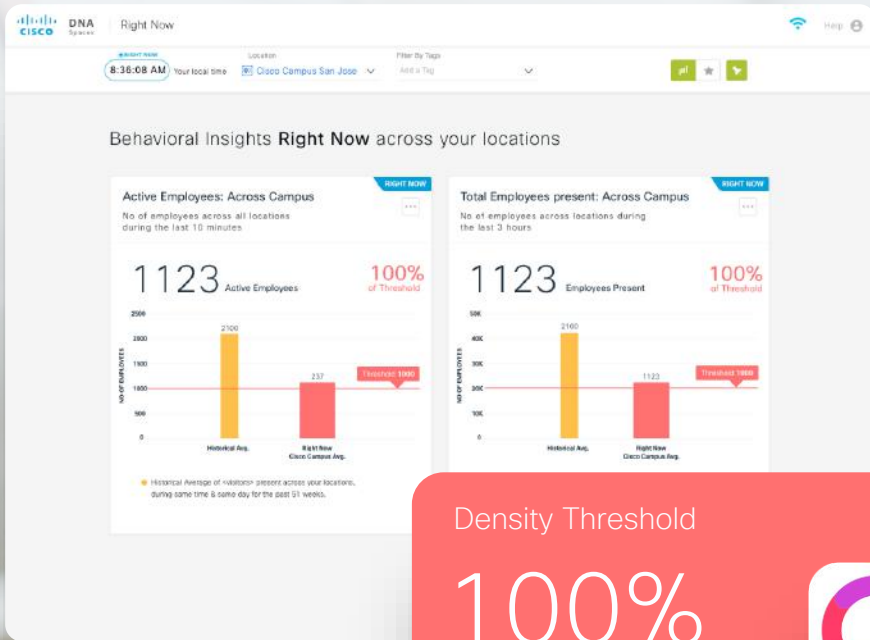
← Create Density Rule RULE NAME: San Jose Campus Density

Choose any or all of the options that apply to your rule below

SENSE

When a user is connected to WIFI and the density is more than 60 visitors per 100 sqft

The rule will trigger when 1 min density counting of the number of connected devices in specified area.



Density Threshold

100%

1123 Total employees in Building 24



Cisco DNA Spaces, 10.47AM

Threshold Alert in Building 24. **Crossed 100%**. Please halt entry of new visitors.

## Notification Trigger

When the threshold is reached a notification is triggered via API using the rules engine

You will be notified via a Webex Teams notification.

# Shrnutí: Monitoring – Analytika – Integrace

- Otevřenost a flexibilita pro správu sítě a monitoring
  - Spolupráce s běžnými provozními nástroji
  - Podpora standardů a programovatelnosti
  - Aktivní vývojářská komunita a partnerský ekosystém
  - Snadná integrovatelnost v rámci vašich ITSM procesů
- Standardní management řešení
  - Tradiční network management nástroj Cisco Prime Infrastructure
  - IBN řešení Cisco DNA Center s pokročilými analytickými funkcemi a AI
- Infrastruktura pro digitalizaci činnosti organizace
  - Přehled a analýza chování připojených zařízení a uživatelů
  - Provázanost stavů a chování s procesy organizace

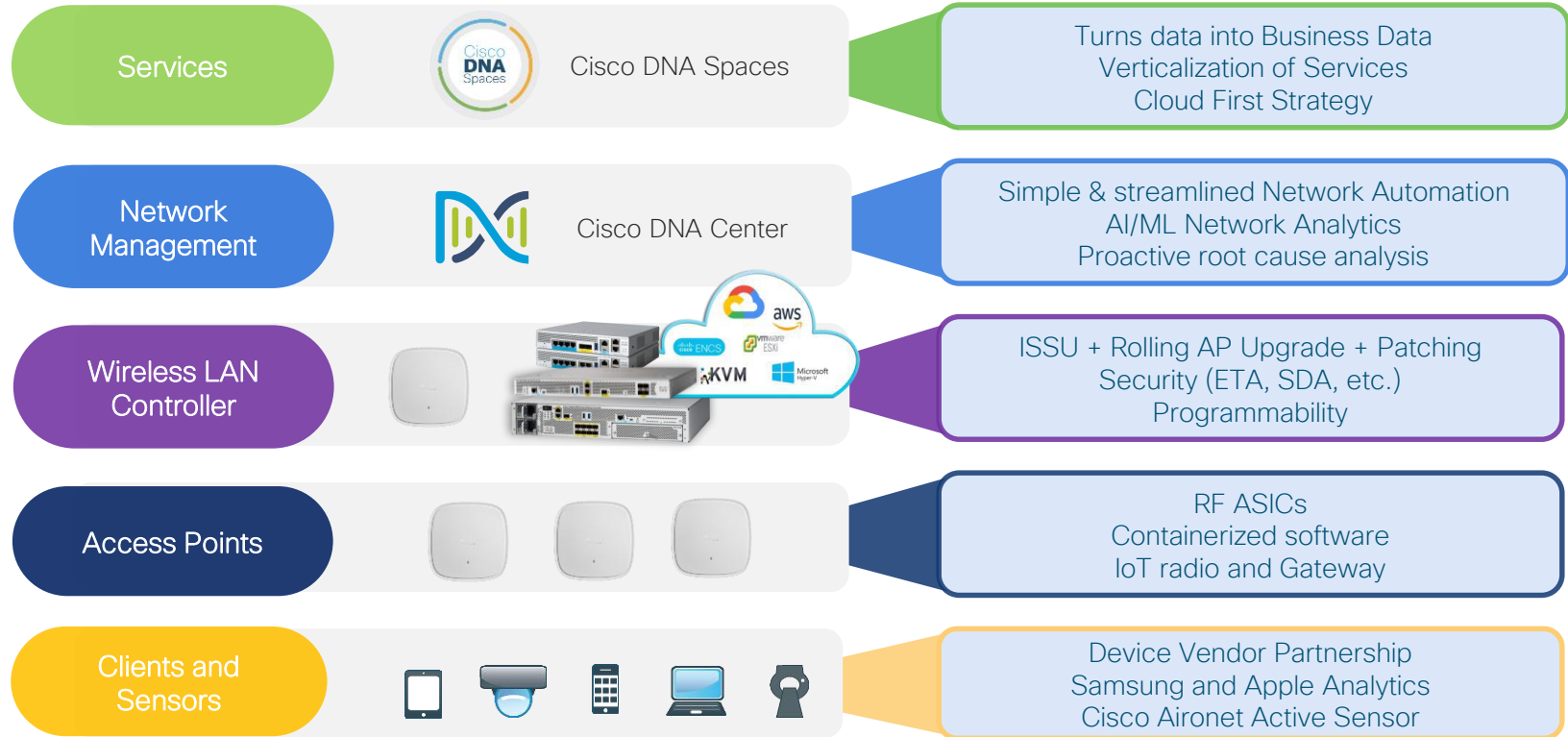


# Úspěšná migrace na Wi-Fi6

Jaroslav Čížek

# Migration to the Next-Gen WLAN Stack – *WHY?*

## Innovation at each layer of the stack



# Migration to the Next-Gen WLAN Stack - *Strategy*

## Evaluation



- Understand the advantages of NG stack
- Build the knowledge of NG stack
- Verify platform support
- Evaluate feature gaps
- Evaluate new licensing model

## Design

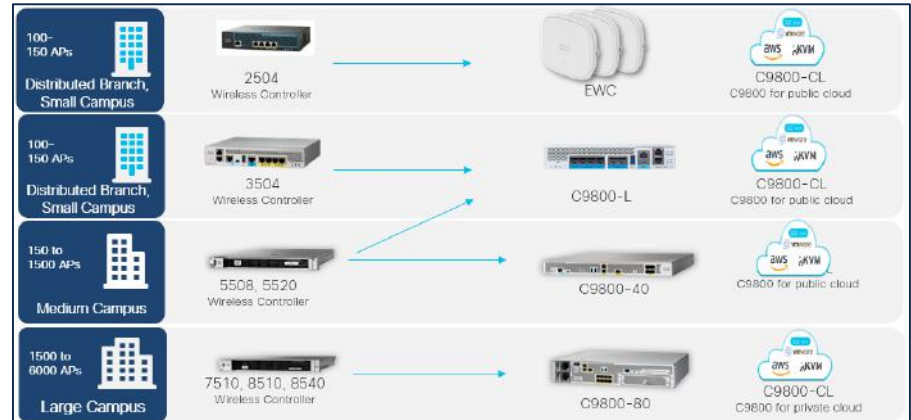
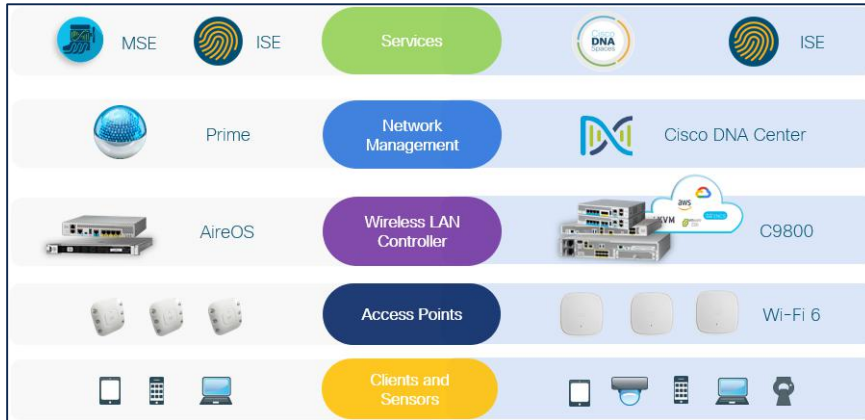


- Select the C9800 and AP platform and chose the deployment mode
- Design for C9800 vs. AireOS WLC coexistence and AP migration areas
- Understand the gotchas
- Choose a Management Platform

## Implementation

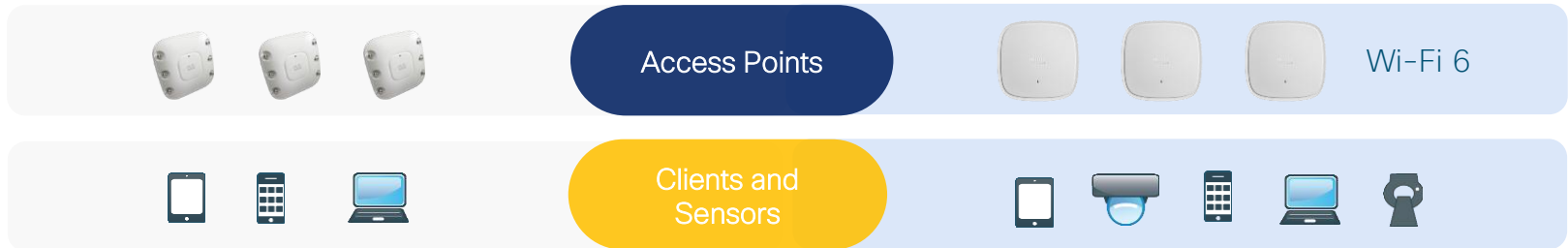


- Check the Site Survey & Heat Map
- Replace the legacy APs
- Check switch PoE
- Lab validation
- Go-Live and Day 2 Support



# Catalyst AP Migration – Important questions

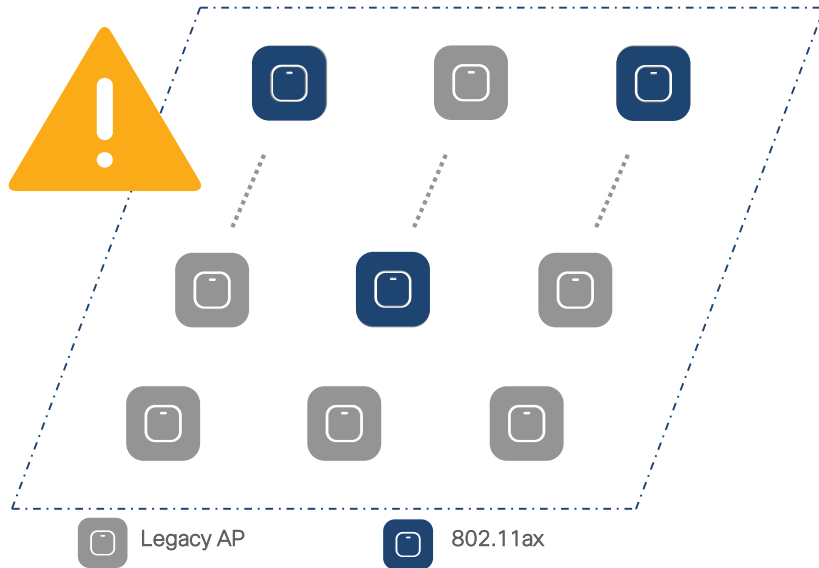
- Do I need a new Site Survey?
- Can I replace APs 1:1?
- How do I deal with “border” areas between APs of different type?
- New Wi-Fi 6 APs, do I need new switches?





# Do I need a new Site Survey?

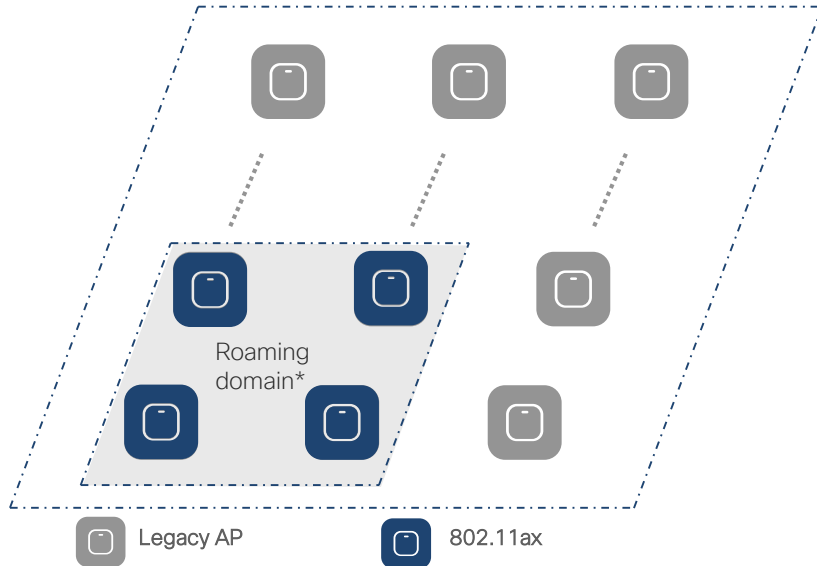
- New Site Survey is **not mandatory** (assuming current coverage meets requirements)
- **1:1 Replacement** assumes the APs were originally installed in optimal place



- New APs are designed to have close to the **same coverage area** as the previous gen product. Coverage will be similar but wireless **capacity will increase**
- “**salt and pepper**” replacement is **not recommended**
- Mixing AP type will prevent customers from taking advantage of the new features being introduced in Catalyst APs (RF ASIC related and Wi-Fi 6 features)

# Do I need a new Site Survey?

- New **Site Survey** is **not mandatory** (assuming current coverage meets requirements)
- **1:1 Replacement** assumes the APs were originally installed in optimal place



- New APs are designed to have close to the **same coverage area** as the previous gen product. Coverage will be similar but wireless **capacity will increase**
- “**salt and pepper**” replacement is **not recommended**
- Mixing AP type will prevent customers from taking advantage of the new features being introduced in Catalyst APs (RF ASIC related and Wi-Fi 6 features)
- **Recommendation:** keep APs of the same type together, replace the APs in a roaming domain
- Roaming domain = e.g. floor/multiple floors /building or area where people tend to roam

# High Density AP Deployment - Enterprise Design Recommendations

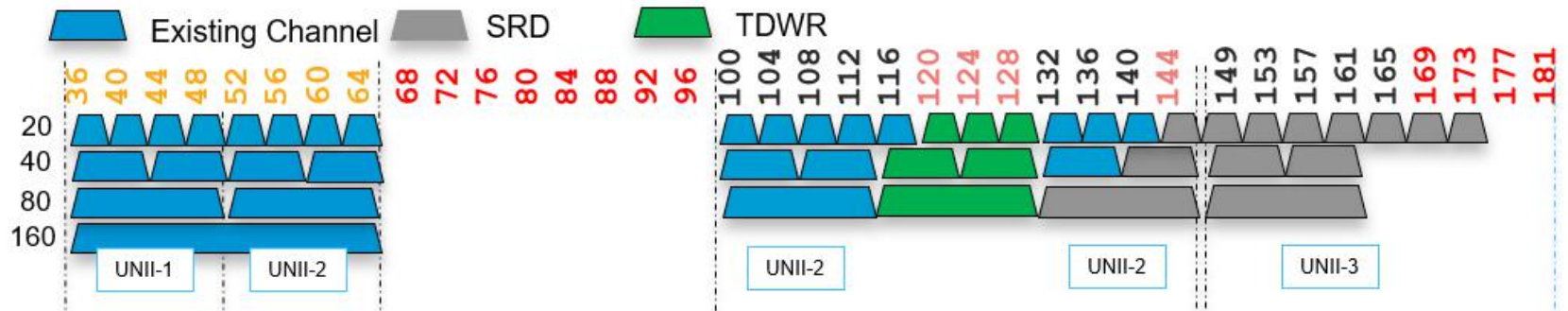
- Does a generalized guideline of 1AP per 2500 ft<sup>2</sup>/(230 m<sup>2</sup>) provide enough capacity for expected increases in application throughput requirements?
- With new digital applications such as 8K video, AR/VR on the horizon do current AP density recommendations meet the demand for the next wave of the digital economy?
- Is a higher density of APs required to satisfy these requirements?

# AP Isolation, Operating Density, and Performance

- Wi-Fi operates on Contention, 2 AP's that hear one another, will share (each get half) the bandwidth, 3 APs will each get 1/3, ...
- If you have more channels than APs, all will be isolated
- Channel bonding requires more channels
- Dual 5 GHz requires 2x the channels per per AP
- AP's must should not hear one another on the same channel above -82 dBm (-78 possible with RX-SOP) interference starts to play a role



19 @ 20 MHz  
9 @ 40 MHz  
4 @ 80 MHz



# How Dense is too dense?

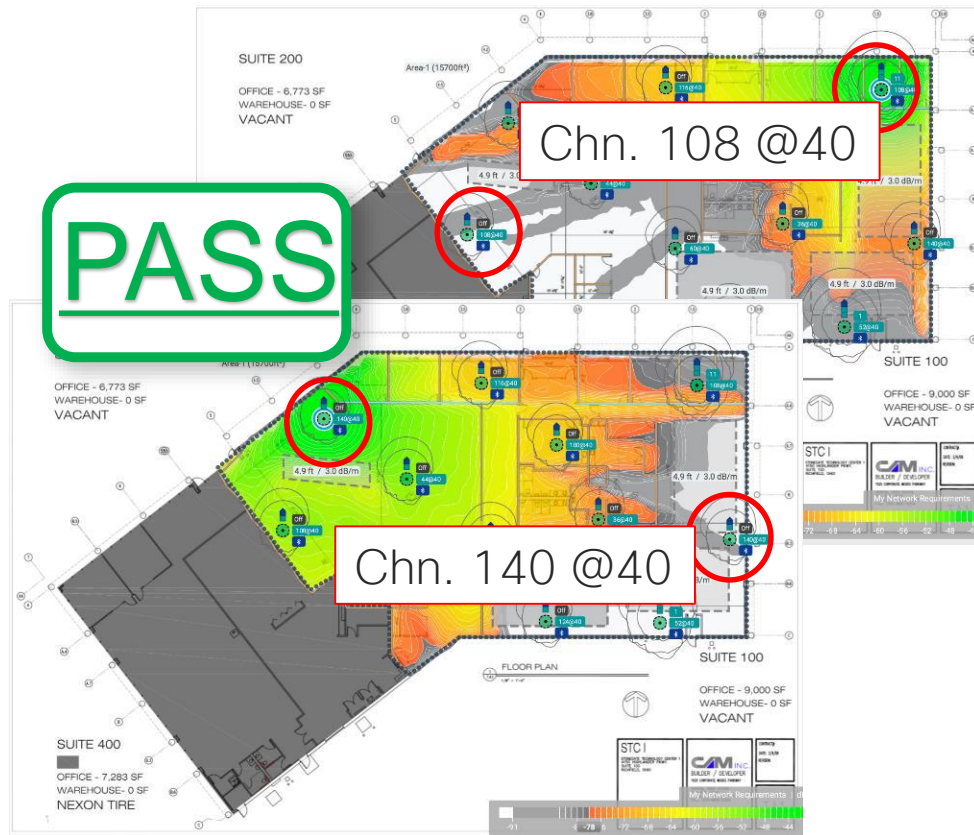
- Richfield, OH. Competitive Labs  
Area is 15K ft<sup>2</sup> / 1.4K m<sup>2</sup>
- Tested 20,40,80 MHz channels @  
3 densities
  - 1k ft<sup>2</sup> = 1 AP every 36 feet (11 m)
  - 1.2k ft<sup>2</sup> = 1 AP every 40 feet (12 m)
  - 1.5k ft<sup>2</sup> = 1 AP every 44 feet (13.5 m)
- Evaluate Channel Plan and usability
- Why? Higher Performance needs  
more Cells/Capacity



More Cells (APs) = More Bandwidth per user

# Co-Channel Interference - 1.2 k ft<sup>2</sup> (AP every 12m) ETSI 40 MHz Channel Plan

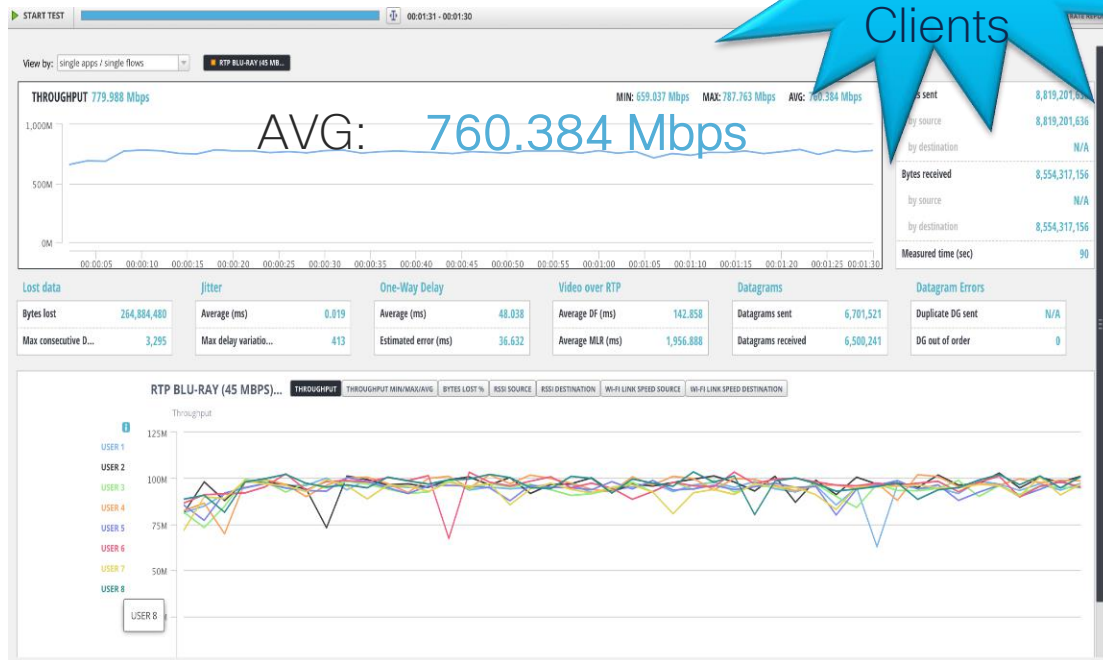
- Using an ETSI channel plan - 9 channels (@40 MHz).
- 12 (APs) / 9 (Chan)= channel reuse rate of 1.3
- The resulting plan forced the assignment of 2 co-channel pairs on Channels 140 and 108 in the graphics to the right, we compare their impact on one another
- Tuning of RX-SOP at -78 would eliminate the co-channel interference
- The two pairs of AP's are not RF close enough to matter



# 40 MHz – Single AP 8 Client Test






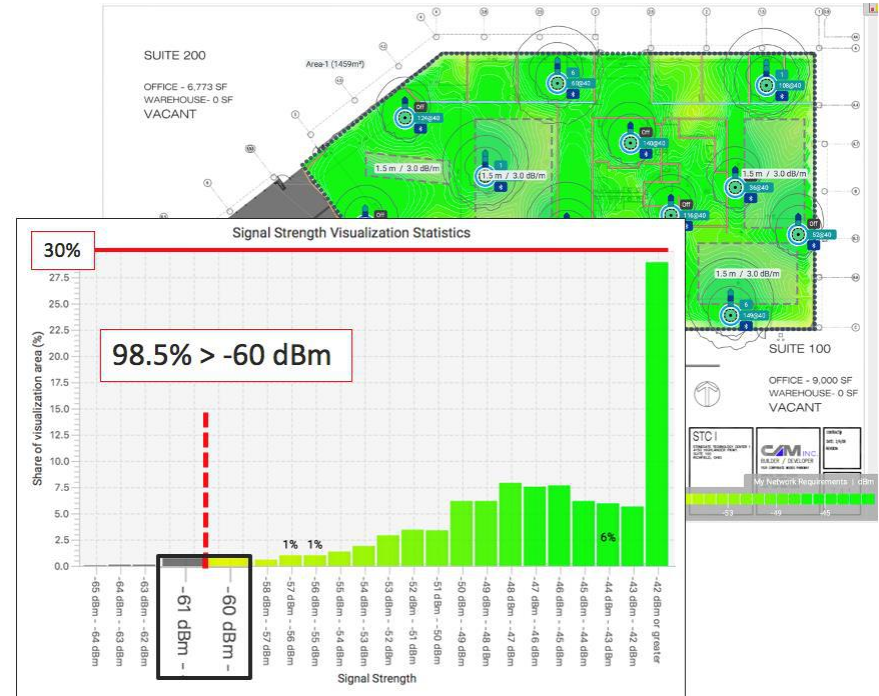
- 40 MHz single cell throughput for 8x 8K video clients performed very well
- 760 Mbps or > 90 Mbps supported for all 8 clients
- One-Way latency <50 ms



# HD Design -Conclusions

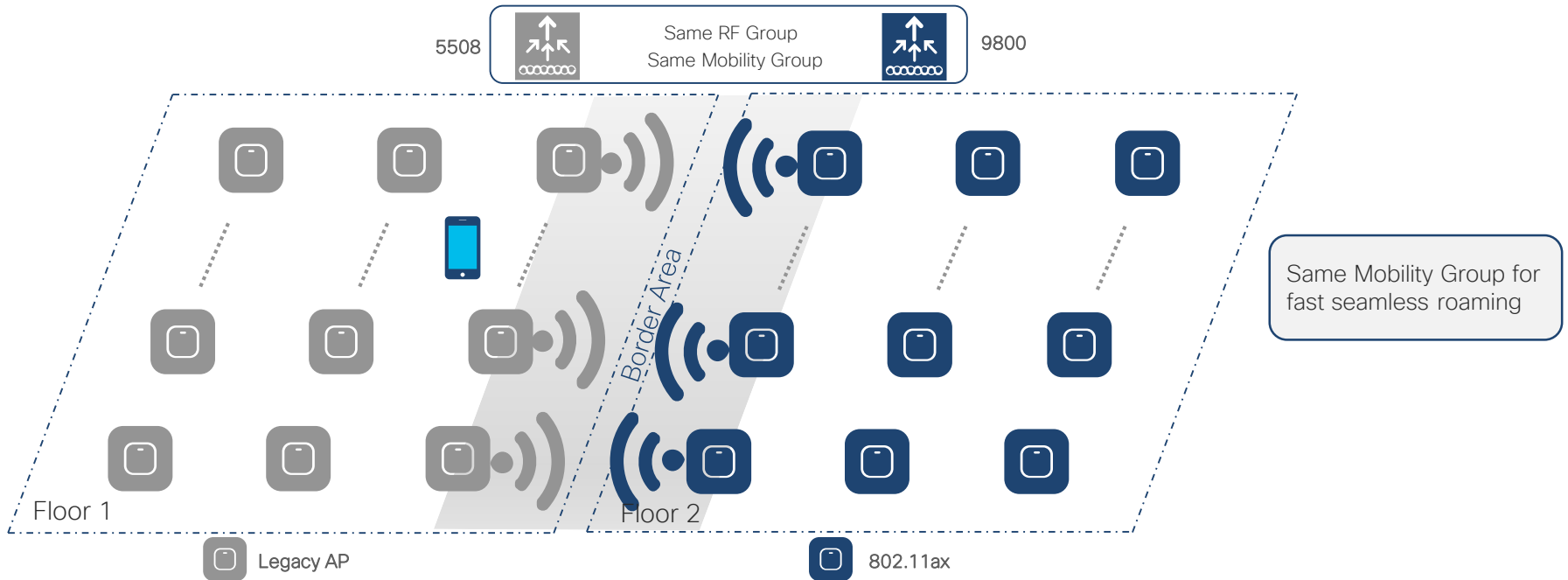
- Density requires channels to separate
- A network is too dense when channel reuse impacts required performance
- Channel Reuse varies by:
  - The number of Available Channels
  - The Channel Bandwidth
    - 20 MHz is 1 channel per interface
    - 40 MHz is 2 channels per interface
- Excellent results between 1.2k and 1.5K ft<sup>2</sup> densities can be supported @40 MHz in FCC and ETSI

Area	1K ft <sup>2</sup> / 93 m <sup>2</sup>	1.2K ft <sup>2</sup> / 111 m <sup>2</sup>	1.5K ft <sup>2</sup> / 130 m <sup>2</sup>
BW	80 MHz	40 MHz	40 MHz
Pass/Fail			



# How do I deal with “border” areas?

- As you replace APs per roaming domain, you will have “border areas” between two deployments
- If you have the same RF Group, Cisco RRM takes care of setting power and channel plan for the border areas.

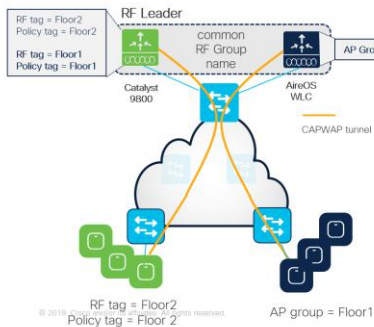


# AireOS and C9800 - coexistence and migration

## RF Group, Roaming, Guest

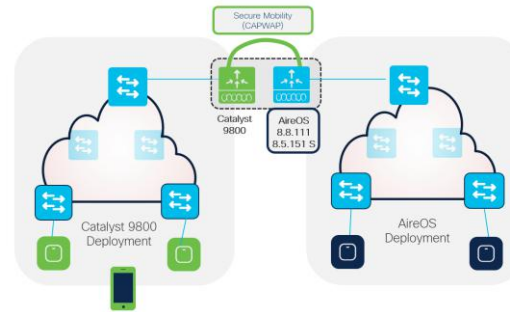
### AireOS to IOS-XE (C9800) migration - common RF Group

RRM works in a mixed controller environment and we can have one RF master:



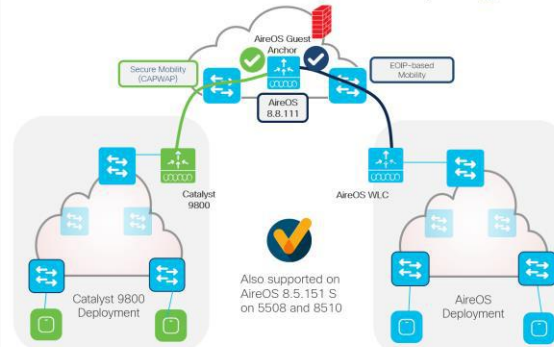
- C9800 and AireOS controllers can create one RF domain and share a common RF plan
- The RF group name on both AireOS and C9800 controllers needs to match
- 8.8 is required on AireOS (8.8.111 recommended)
- A RF leader is elected (based on controller capacity) and common channel and power plan will be used for all APs
- APs will be not show up as rogue on the other controller
- NOTE: in a scenario where you want to have custom RF profiles or enable FRA, then the leader (e.g. C9800 controller) needs to have Policy and RF tags matching the names of the AP Group names on AireOS WLC. Of course the settings of RF profiles on both controllers need to match as well.

### AireOS to IOS-XE (C9800) migration - Roaming



- During migration, if customer plans to cover the same areas with AireOS and C9800 controllers, then Mobility Group needs to be considered
- Mobility Group provides seamless roaming between wireless controllers
- Mobility Group between AireOS and IOS-XE WLCs is only supported on:
  - 3504, 5520, 8540 with 8.8.111 and higher
  - 5508 and 8510 with 8.5.151 special
- This is because C9800 only support CAPWAP based mobility tunnels (Secure Mobility)
- Note: Secure Mobility is NOT supported on WISM2

### AireOS to IOS-XE (C9800) migration - Guest



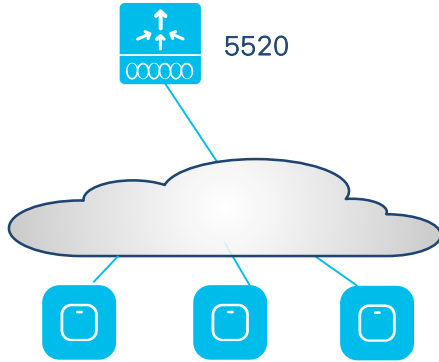
- For Guest, AireOS WLC running 8.8.111 and higher can talk both tunneling protocols and
- It can provide Guest Anchor functionalities for both the new C9800 based deployments and the legacy AireOS based network

Also supported on AireOS 8.5.151 S on 5508 and 8510

chored to the first WLC that the client joined

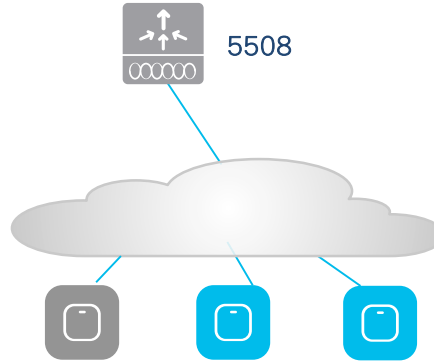
# C9800 migration: common customer scenarios

Scenario A



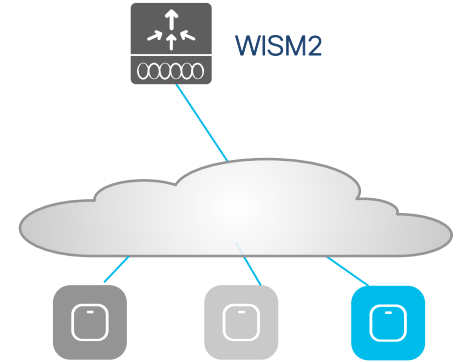
Mix of 802.11ac APs

Scenario B



Mix of 802.11n and 802.11ac APs

Scenario C

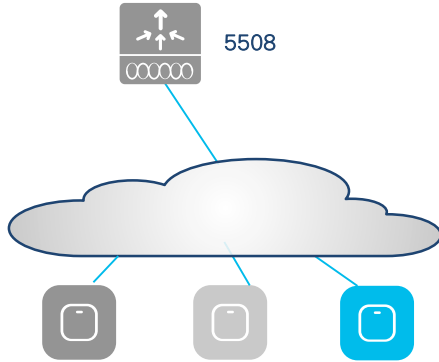


Mix of 802.11n and 802.11ac APs

Goal: migrate to Catalyst 9800 controller and Catalyst APs

# C9800 migration: scenario B

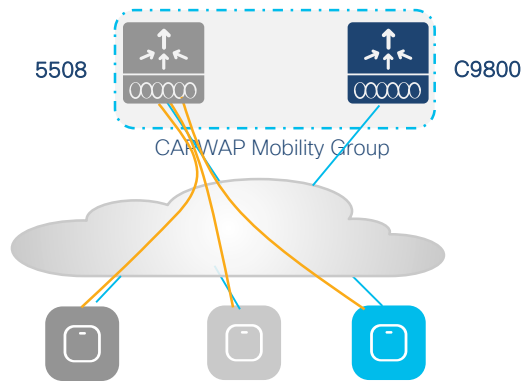
## Scenario B



Mix of 802.11n and 802.11ac APs

- 5508 do not support 11ax APs
- User need to add the C9800 first
- 802.11n APs are not supported with C9800 and will need to be replaced

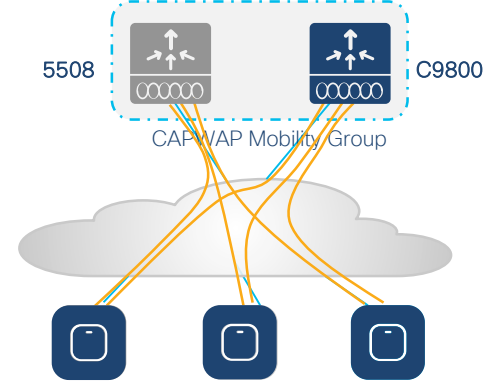
## First step



Add new C9800 first

- Upgrade 5508 to 8.5.164 image
- Add C9800 and migrate licenses
- Create CAPWAP Mobility Group
- Seamless mobility during migration

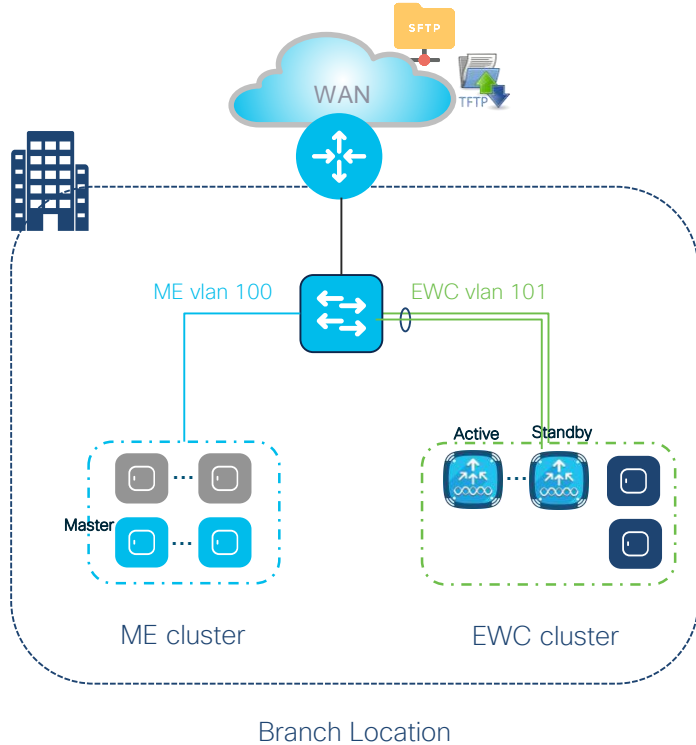
## Second step



Migrate to new 802.11ax APs

- Replace 802.11n APs with 11ax APs  
1:1 AP replacement if coverage is correct  
Don't "Salt & Pepper" old with new AP model  
Connect new 802.11ax APs to 9800
- Move 11ac APs to 9800
- Move APs per roaming domain area
- Decommission 5508
- Replace 11ac APs with new 11ax APs

# Mobility Express to EWC migration



W1 802.11ac APs



11ax C9100 APs



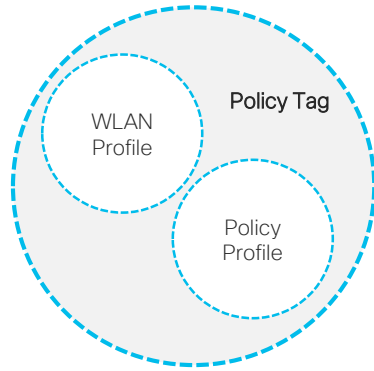
W2 802.11ac APs

## Migration steps:

- Move the subordinates W2 11ac APs to the EWC VLAN. Do shut/no shut on the switchport so that AP will re-DHCP
- These APs will join the EWC controller and download the new image (Note: you need a TFTP/FTP server for APs to download the EWC image)
- During migration, as all the APs advertise the same SSIDs and the same client VLANs are mapped on the trunk. The client will have to re-authenticate as seamless roaming doesn't work across ME and EWC deployments
- **Note:** the W2 11ac APs that are running the ME capable image, need to be converted to CAPWAP APs before they can join the EWC. Follow these instructions:
  - Once the ME AP has no more APs connected issue the following CLI command "`config ap unifiedmode <EWC hostname> <EWC IP>`"
  - ME AP will reboot and become a CAPWAP AP that can join the EWC
- The older W1 11ac APs are not supported and need to be swapped with C9100 APs that will directly join the cluster
- The ME cluster can be decommissioned



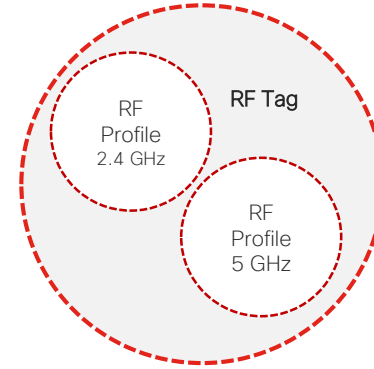
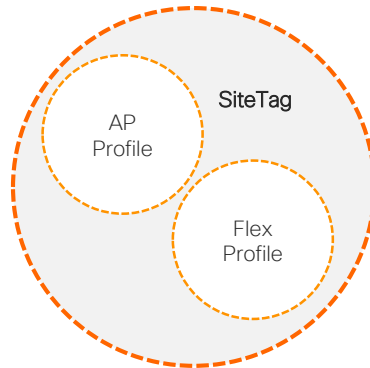
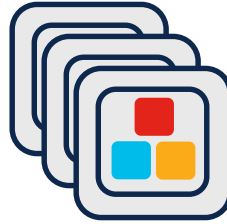
# Catalyst 9800 Config Model



- Defines the **Broadcast domain** (list of WLANs to be broadcasted) with the policies of the respective SSIDs
- “Equivalent” to AP Group in AireOS



Access Points



- Defines the RF properties of the group of APs

- Defines the properties of the central/remote sites
- Defines the **roaming domain for Flex APs**
- “Equivalent” to Flex Groups in AireOS but only for Flex APs
- Max Flex APs per site tag is 100 for seamless roaming



Reference

# Best Practice Guide on CCO

Direct url: <http://cs.co/c9800-BP>

Products & Services / Wireless / Wireless LAN Controller / Cisco Catalyst 9800 Series Wireless Controllers / White Papers /

## Cisco Catalyst 9800 Series Configuration Best Practices

Updated: May 7, 2020

Contact Cisco

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### Introduction

The Cisco Catalyst 9800 Series (C9800) is the next-generation wireless LAN controller from Cisco. It combines RF excellence gained in 25 years of leading the wireless industry with Cisco IOS XE software, a modern, modular, scalable, and secure operating system. The Catalyst Wireless solution is built on three main pillars of network excellence: Resiliency, Security, Intelligence:

Cisco Catalyst 9800 Series Wireless Controllers  
Power by Cisco IOS XE Open and programmable

Cisco Catalyst 9100 Access Points  
Power by Wi-Fi technology Superior RF experience

Resilient  
ISSU

Secure  
User Define Network

Intelligent  
11ax Analytics  
Samsung Analytics



Reference

# Best Practice - Dashboard

- C9800 (in 16.12.1s and later) introduces the same Best Practice dashboard

Administration > Best Practices

Best Practice Score: 22/24

**INFRASTRUCTURE**

- + Disable Aironet IE
- + Disable Management Over Wireless
- + HTTPS for Management
- + More Optimizations...

**SECURITY**

- + WLAN with WPA2 or 802.1X
- + Client Exclusion
- + User Login Policies

**RF MANAGEMENT**

- + Auto Coverage Hole Detection
- + Auto Dynamic Channel Assignment
- + Auto Transmit Power Control
- + More Optimizations...

**APPLE DEVICES**

- + WLAN Configuration
- + Optimized Roaming Disabled

Cisco 5520 Wireless Controller

**BEST PRACTICES** Best Practice Score: 24/33

**INFRASTRUCTURE**

- + Application Visibility
- + Controller High Availability
- + Disable Aironet IE
- + More Optimizations...

**SECURITY**

- + 802.1x on AP
- + CPU ACLs
- + Client Exclusion
- + More Optimizations...

**RF MANAGEMENT**

- + Auto Coverage Hole Detection
- + Auto Dynamic Channel Assignment
- + Auto Transmit Power Control
- + More Optimizations...

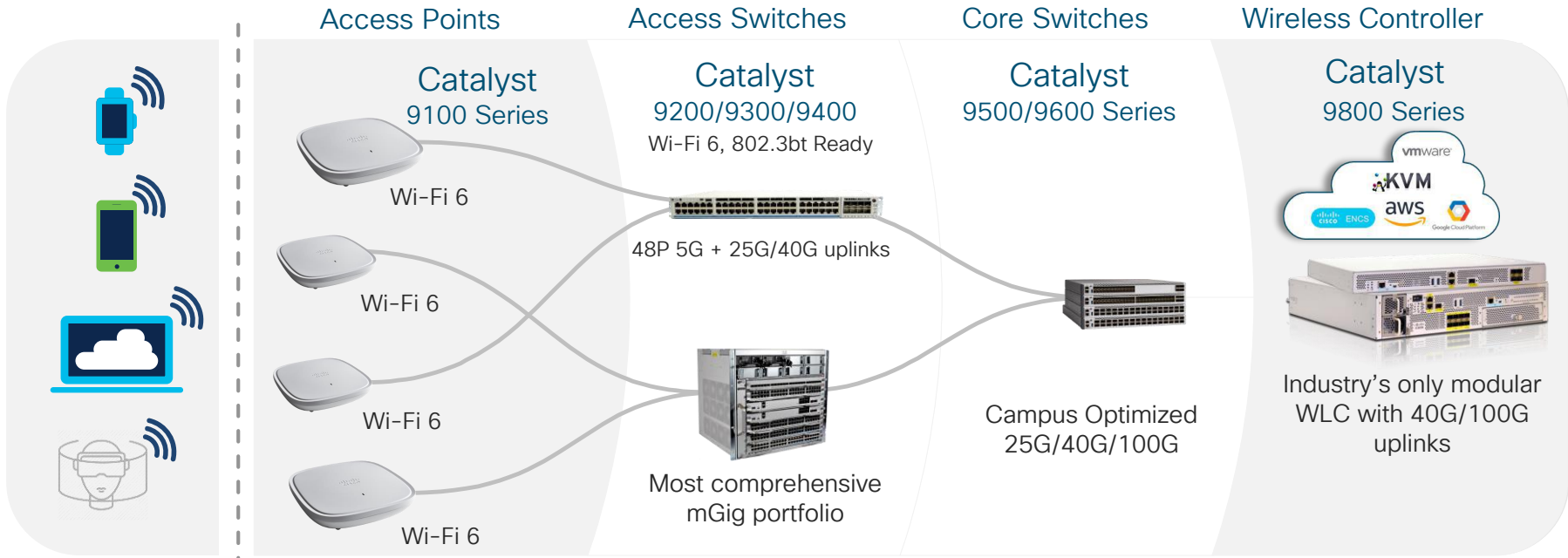
**APPLE DEVICES**

- + WLAN Configuration

- But there are some differences that you should be aware...

# Cisco Catalyst - End-to-end Network

Enabling next-generation Wi-Fi 6 mobility

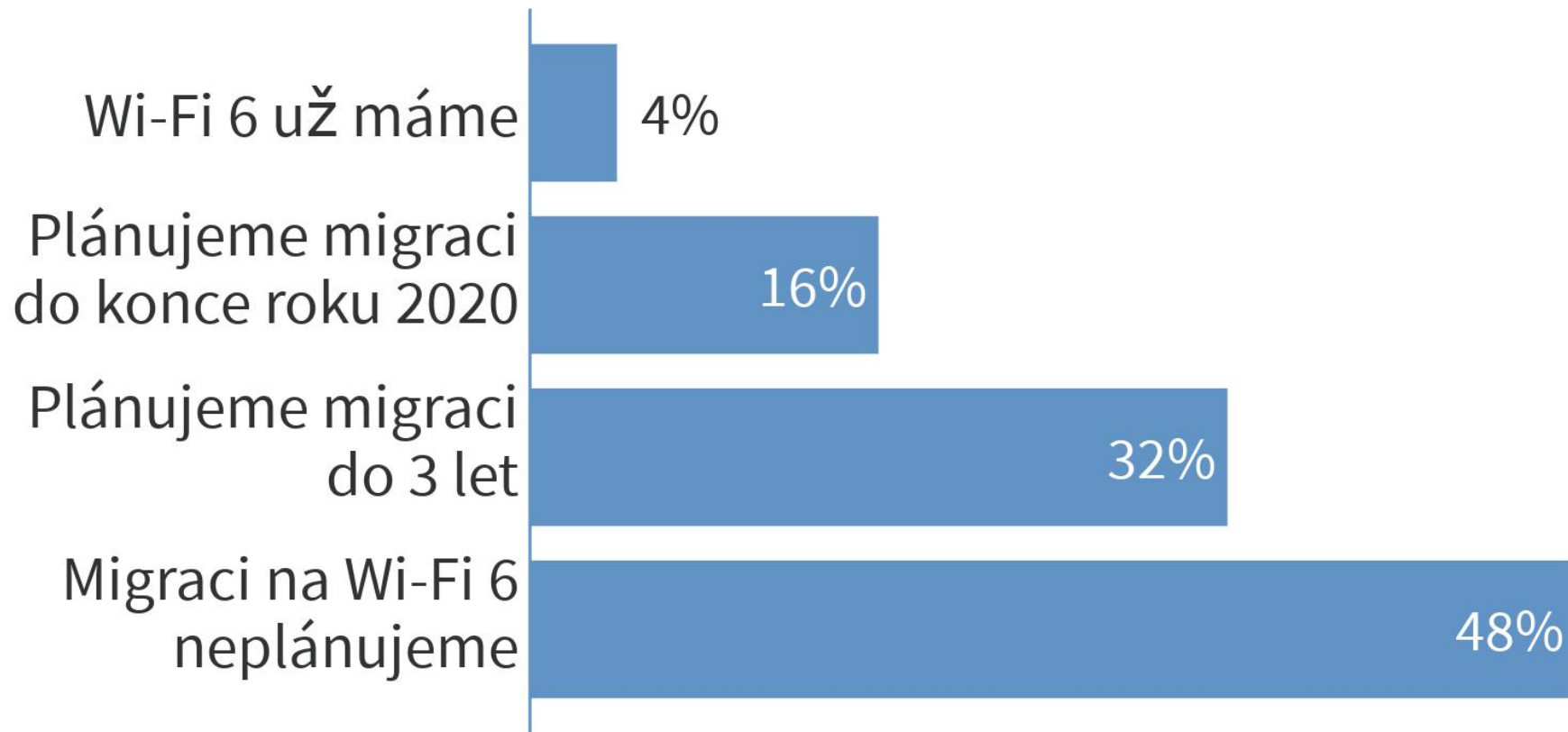


← The Full Experience End to End →

Built for Intent-based networking

- Automation
- Security
- Analytics

# Plánujete přechod na Wi-fi 6?





Připravte si infrastrukturu na novou realitu

Bezdrátové sítě | 23. 6. 2020

# Závěrečné shrnutí



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# Program



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## Blok 1

9:30	Rozhovor s expertem – Petr Krčmář, šéfredaktor root.cz Losování soutěže root.cz	<i>Pavel Křížanovský</i>
9:45	Poznejte možnosti Wi-Fi6 a WPA3	<i>Jarda Čížek</i>
10:00	Jak se staví WLAN síť?	<i>Milan Rášo</i>
10:15	Jak vybírat komponenty pro síť Wi-Fi6? (část 1)	<i>Jarda Čížek</i>
10:30	Jak vybírat komponenty pro síť Wi-Fi6? (část 2)	<i>Milan Rášo</i>
10:45	Shrnutí úvodní části	

Přestávka

## Blok 2

10:55	Proč jsme přešli na Wi-Fi6 - zkušenost společnosti Teleplan	<i>Pavel Křížanovský</i>
11:05	Mějte Wi-Fi pod kontrolou - živé demo	<i>Zdeněk Roubal, Jarda Čížek</i>
11:15	Monitoring - analytika - integrace	<i>Zdeněk Roubal</i>
11:30	Návod: úspěšná migrace na Wi-Fi6	<i>Jarda Čížek, Milan Rášo</i>
11:45	Závěrečné shrnutí	

11:50 Otázky a odpovědi

12:00 Závěr



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# Otázky a odpovědi



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# Připravte si infrastrukturu na novou realitu

Přepínané sítě | 25. 6. 2020 9:30

Pozvánka na čtvrtek

- Architektury a trendy v přepínaných sítích
- Rozhovor se zákazníkem Agrostroj
- Programovatelnost – živé demo
- Síťové bezpečnostní mechanismy



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Děkujeme



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